Quebec (Prov.). Mines, Dept. of

PROVINCE OF QUEBEC, CANADA

Department of Colonization, Mines and Fisheries

BUREAU OF MINES

Honourable HONORÉ MERCIER, Minister : : S. DUFAULT, Deputy-Minister

THÉO. C. DENIS, Superintendent of Mines

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REPORT ON

MINING OPERATIONS

IN THE

PROVINCE OF QUEBEC

DURING THE YEAR 1918

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PROVINCE OF QUEBEC, CANADA

Department of Colonization, Mines and Fisheries

BUREAU OF MINES

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Province of Quebec

DEPARTMENT OF COLONIZATION, MINES AND FISHERIES

To the Honourable Honoré Mercier,

Minister of Colonization, Mines and Fisheries,
Quebec.

Sir,—

I have the honour to transmit to you the Annual Report on the "Mining Operations in the Province of Quebec" for the year ending December 31st, 1918.

I remain, Sir,

Your obedient servant,

S. DUFAULT,

Deputy Minister.

Quebec, May 6th, 1919.

Province of Quebec

DEPARTMENT OF COLONIZATION, MINES AND FISHERIES

BUREAU OF MINES

Mr. S. Dufault,
Deputy-Minister of Colonization,
Mines and Fisheries, Quebec.

Dear Sir,—

I beg to transmit to you the Annual Report of the Bureau of Mines of the Department, for the year ending December 31st, 1918.

This report, entitled "Mining Operations in the Province of Quebec during 1918," gives the statistics of production of the mines and quarries; of labour employed in the mining industry in the Province; of mining accidents which occurred; a synopsis of the mining operations and development during the year, and the reports of the geological field-work done in 1918.

As in past years, the report on "Mining Operations in the Province of Quebec in 1918" was preceded, on February 26th, by a statistical statement of the mineral production, giving provisional figures subject to revision. The present report gives the revised statistical figures, and the tables given in this volume supersede those of the preliminary statement.

Yours very obediently,

THÉO. C. DENIS,
Superintendent of Mines.

Quebec, May 6th, 1919.

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NOTE

In the statistical tables and in the review of the mining industry of the province during the year, the term "production" is synonymous with "quantity sold or shipped," and does not necessarily represent "output." The ore and other mineral products remaining as "Stock on hand" at the end of the year are not included in the production figures.

The ton used throughout is that of 2,000 lb., except when specially mentioned.

The year referred to is the calendar year, ending December 31st unless specially stated.

We endeavour to give values of the mineral products, raw or manufactured, as estimated at the point of shipment or at the pit-mouth; this, however, is sometimes difficult to obtain.

MINING OPERATIONS

IN THE

PROVINCE OF QUEBEC

DURING THE YEAR 1918

STATISTICAL REVIEW

As during the preceding three years, the mining industry of the Province of Quebec benefited from the war activities during the year 1918, and until the signing of the armistice, on November 11th, bringing the world's cruel struggle to the victorious issue which had been so long yearned for, the mining operations were only limited by the lack of adequate labour. This remark applies essentially to the "products of the mines" proper, as distinct from the building materials, such as stone, brick, lime, cement, the production of these having seriously declined during the last four years.

The abnormal conditions which so disorganized the international exchange of raw materials, mainly through lack of ocean transportation, were responsible for the local intensified production of minerals necessary for the manufacture of war material. Of these war-minerals, the Province of Quebec produced pyrites, chromite, asbestos, molybdenite, and until the signing of the armistice all the deposits of these minerals large enough to be of economic importance were actively worked. The stimulation and development which have quickened the magnesite, molybdenite and chromite industries in the Province, are directly imputable to the war needs.

The cessation of hostilities will have a depressing effect on the mining industry. It is feared that chromite mining will decrease to a small fraction of what it has been in the last three years. Already the number of operators in the Coleraine field has dwindled down from twelve in August, 1918, to two in March, 1919.

It is hoped that the magnesite industry received a sufficient impetus during the war to now stand on its own merits. The consumers who have used Quebec magnesite, raw or dead-burned, are thoroughly satisfied with the results obtained.

The total value of the production of the mines and quarries of the Province of Quebec in 1918 is the highest ever recorded. It reached $18,707,762. This is an increase of $2,518,583 as compared with the previous year or a proportional increase of 15.6%.

The short table given below is a comparison, in million dollars, of the mineral production, divided into three main subdivisions, for the year before the war and for the year 1918. It shows very clearly the influence which this great struggle had on our mineral industry.

SUBSTANCES PRODUCED	1913	1918
Building materials: stone, lime, brick, cement	8	5½
Non-metallic minerals: asbestos, magnesite, mica, graphite, etc	4½	10¼
Metallic minerals: pyrites, copper, chromite, molybdenite, lead and zinc	½	3
Totals	13	18¾

Therefore, the value of the yearly production of non-metallic minerals has more than doubled; the metallic minerals now figure in the table for a value of six times that of the pre-war production, whereas the building materials are considerably below. With the advent of peace we may expect a decrease in the products of the mine proper, but it is hoped that the renewal of activity in the structural material production will to some extent compensate this falling off. Nevertheless, it is possible that the year 1918 may, for some time, remain the banner year.

The following table gives the annual value of the mineral production of the Province of Quebec, for the past eighteen years, and it illustrates the progress of the industry during that period:—

YEAR	VALUE	YEAR	VALUE
1901	$ 2,997,731	1910	$ 7,323,281
1902	2,985,463	1911	8,679,786
1903	2,772,762	1912	11,187,110
1904	3,023,568	1913	13,119,811
1905	3,750,300	1914	11,732,783
1906	5,019,932	1915	11,465,873
1907	5,391,368	1916	13,287,024
1908	5,458,998	1917	*16,189,179
1909	5,552,062	1918	18,707,762

*Through a duplication of returns in one of the items this was erroneously given as $16,266,480 in the Report for 1917.

TABLE OF THE MINERAL PRODUCTION OF THE PROVINCE OF QUEBEC DURING 1918

SUBSTANCES	No. of workmen	Salaries	Quantities	Value	Value in 1917
		$		$	$
Asbestos, tons	3,170	2,991,292	142,375	9,019,899	7,198,558
Asbestic, tons	.....	.....	16,850	34,046	42,139
Chromite, tons	345	300,672	36,131	770,955	498,031
Copper and Sulphur ore, tons	408	390,450	125,446	1,319,690	1,205,242
Feldspar and Kaolin, tons	61	39,262	1,125	24,103	19,969
Gold, oz	26	23,071	1,578	32,615	22,570
Graphite, lb	169	29,336	326,308	33,274	99,024
Iron and titaniferous iron ores, tons	81	20,948	6,860	33,726	54,135
Magnesite, tons	300	328,404	28,564	1,016,764	729,025
Mica, lb	133	64,604	905,521	202,149	281,234
Mineral waters	13	2,419	.....	6,111	6,553
Mineral paints (Iron oxide, ochre) tons	95	49,375	17,317	112,440	69,536
Molybdenite, lb	237	197,617	342,296	383,252	238,096
Phosphate, tons	.....	.....	140	1,200	1,320
Quartz and Silica, tons	98	31,742	23,286	61,669	32,511
Silver, oz	.....	.....	142,829	139,788	78,880
Zinc and lead ores, tons	208	171,479	7,636	175,094	*165,477
BUILDING MATERIALS					
Brick, M	538	262,427	52,367	595,719	530,594
Cement, bbls	388	448,688	1,564,341	3,003,534	3,264,664
Granite	235	151,354	.....	224,861	167,659
Lime, bush	203	125,142	1,607,708	438,673	343,588
Limestone and marble	815	358,221	.....	666,046	749,592
Sand, building	66	35,126	.....	87,308	161,840
Slate, sq	19	11,298	933	5,124	7,789
Sandstone	.....	.....	.....	.....	7,475
Tile, drain and sewer pipe, pottery, etc	183	116,521	.....	319,722	213,678
	7,791	6,149,448	.....	18,707,762	*16,189,179

*Through a duplication of returns these figures were too high in the Report for 1917.

INDUSTRIAL RECONSTRUCTION

Industrial disorganization, following the cessation of the intensive efforts in the super-production of war material during the last three years, and the endeavour to reorganize these efforts in the channel of peace industries, have given rise to social and economic unrest. This is further aggravated by the problems of demobilization of hundreds of thousand of soldiers, who in the army and especially in the trenches, have acquired a new mentality, which in some cases, may render more difficult their re-adaptation to pursuits of peace times.

In a very able paper, given before the Canadian Mining Institute in March 1919, Mr. C. V. Corless expresses himself as follows on the subject of labour being given a voice in the management and control of industries, and his remarks apply very aptly to the mining and metallurgical industries:

"The discontent of labour only deepens from month to month It is not low wages, or bad working conditions or long hours, or want of holidays or of other concessions, or any or all of these complaints, taken singly or together, that constitute the real grievance of labour and that form the basic cause of the continual strife which frequently culminates in trials of strength and endurance. To grant any or all of these does not give any assurance of cessation of demands or of permanent improvement in the relations between capital and labour.

"What then is the essence of this seemingly endless difference? What is the underlying cause of the great industrial unrest? What is the principle for which (though perhaps labour itself, or even capital, may not always recognize it clearly) the contest is in reality continually being waged? There are probably very few men who would not be willing to earn less, to work harder and for longer hours, or under worse conditions, or to get on with fewer holidays, if it were done for themselves in any undertaking in which they really felt a deep personal interest. But in modern industry, they do not feel personally interested. They have no sense of ownership. They never begin or finish anything. They do not have the opportunity to think for themselves . . . . They have very little if any sense of responsibility. They have little or no voice in governing themselves. They are parts of an organization, cogs in an economic machine, which they do not fully understand, and in which they

almost lose their identity, that is, their freedom for self-development. Somebody, somewhere, shapes the organization and sets it in motion, but the part of the organization they see or of the work they perform usually has little, if any, scientific or social meaning to them. Hence their spirit rebels. The human spirit, unless it has been utterly suppressed, is fortunately so constituted that it always rebels against any form of external authority in which it has no share and which it does not intelligently grasp.

"This deep love of real freedom is one of the most distinguishing characteristics of the human spirit and lies at the very heart of all human progress . . . . The sooner we recognize this single simple principle as the root cause of the existing industrial antagonism, just so much the sooner shall we begin to work intelligently toward a permanent solution of the problem which faces us in the continual, but often clouded, struggle between capital and labour . . . . England already recognizes this and, as all are now fully aware, has, under the '*Whitley Scheme*', of which I gave a brief preliminary account before the Canadian Mining Institute last spring, adopted the idea as a government policy. Her industries, in particular those most highly organized on the side of both capital and labour, are being organized under this scheme. Many Joint Industrial Councils are already formed . . . . This government recognition of the principle of representation of the governed in industrial relations is a first, but an enormous, step in the right direction.

"A fair and proper sharing in the control of industry among the several co-operating factors will gradually bring about that feeling of interest and responsibility, and that just division of the joint product among the interested parties, which will restore the incentive to do one's best and will make industry once more, as it should always have remained, the handmaid of human welfare . . . The Joint Industrial Councils (of national scope in each industry), the District Councils, and the Shop Committees, are based on equal representation of capital and labour."

The so called "Whitley scheme" is the result of a commission appointed in 1917 by the British Government to investigate the causes of industrial unrest and to suggest remedial measures, in which Mr. Whitley took a prominent part. The report which was adopted by the Government, provides for:

1. Joint Standing Industrial councils to be established in all the well-organized industries, with as little delay as possible.

2. That these councils would be considered by the Government as "official standing consultative committees" on all future questions affecting the industries which they represent, and would be the normal channels through which the opinion and experience of an industry will be sought on all questions with which the industry is concerned.

3. That the councils are to be "independent bodies" electing their own officers and free to determine their own functions and procedure with reference to the peculiar needs of each trade. These autonomous councils will thus make possible a larger degree of self government in industry than exists to-day.

"These joint standing Industrial Committees, of national scope for each well organized trade, will be supplemented by districts councils, and these again by Shop Committees, on both of which masters and men will find equal representation....." .....

"On considering the question of representation a little more closely, it seems probable that the labour representatives on the District and National Councils under the Whitley scheme, will all be trade union leaders, while the representatives of the employers will all be professional managers. The workman at the bench or lathe or loom, or in the mine or elsewhere, is generally not in close sympathy or close touch with either. If he is to feel co-operation between those who direct and those who perform the work, it will largely be through the Shop Committees. Success of the scheme will largely depend on perfectly frank, human intercourse between the representatives of both, Councils and Committees, but above all, of the Shop Committees. If, as is hoped, such an atmosphere will be created that trade disputes will never be carried to the breaking point, there will have to be of necessity the greatest sympathy, frankness and cordiality, between the representatives of the workmen and of the management of these Shop Committees.

. . . . "The Whitley scheme' will bring about a discussion on equal terms, of all the conditions of co-operation of Capital and Labour. After many of the minor questions have been satisfactorily settled, inevitably, the question of the just distribution of the joint product of the wealth produced jointly by the co-operation will come into the discussion."*

---

* C. V. Corless, Canadian Mining Institute transactions. Vol. XXI, 1918.

MINING VENTURES AND THE PUBLIC

With the resumption of more normal trade and industrial conditions will probably come the re-appearance of the professional promoter of more or less avowable enterprises, issuing beautifully engraved stock certificates and brilliant prospectuses.

Although such activities are not limited to mining, it must be owned that the lure of returns of one thousand to one on the money invested in mining ventures, as usually inferred by the promoting literature, often attracts and entraps men otherwise sane and of keen business acumen. These last three years have been very prosperous and a great deal of savings have been accumulated, both in rural and urban communities, as demonstrated by the success of the various war-loans issued by the Government. This may prove an incentive to shady and questionable promoters to launch new efforts to make victims, especially in rural communities and among urban people of small means.

Many warnings have been issued through the annual reports of the Quebec Bureau of Mines, guarding the public against the insidious literature and glowing statements of agents, offering mining shares and beautifully engraved certificates in ventures which have never had a chance of success.

Therefore, before putting their hard-earned savings into mining or other ventures, of which they personally know little or nothing, the investing public should enquire from reliable and disinterested sources as to the value and chances of success of such enterprises. The statements and promises of agents, whose sole interest is to sell shares, should not be taken without thoroughly investigating them.

The investing public should discriminate between "mines" and "prospects." Some producing mines, or mines well developed, constitute as safe an investment as any other commercial and industrial enterprise, but these rarely yield more than a fair return. On the other hand, "prospecting" and "developing," be it for ores, for natural gas, for oil, are naturally hazardous ventures. When successful, the returns from such investments are large, but failures are infinitely more numerous than successes. Such investments are not for the small savings, for it should always be remembered that the risk is proportionate to the returns. If the investor expects large returns he has to take risks of losses. And before buying shares in com-

panies searching for, or developing, deposits of gold, lead, zinc or other minerals, or carrying on boring operations for gas and oil, the public should investigate the statements made by the peddlers of stock certificates, enquire from reliable sources as to the possibilities of the enterprises, so as to be able to discriminate between (1) "safe mining investments," (2) "legitimate and reasonable mining speculation," and (3) "mining frauds." In the first the returns are not high but are reasonably sure; in the second, the money contributed by the buyers of shares is really expended in intelligent search and development on the mineral deposits, which may or may not answer the hopes which were founded on them; and the third class comprises the ventures of shady adventurers who spend the money obtained from the sale of shares on full page advertisements, in printing alluring and tempting prospectuses for the purpose of obtaining more money, of which the smallest possible fraction is expended in actual work—usually on hopeless mining claims.

The Bureau of Mines is entirely at the disposal of the public for technical information regarding the mines and mineral resources of the Province of Quebec. An enquiry on such subjects, addressed to the Department of Colonization, Mines and Fisheries, Quebec, will always bring to the writer information from which he usually can judge of the merits of mining ventures in the Province, and this will enable him to go into it with a better knowledge of the facts.

CHEMICAL LABORATORY

The Quebec Bureau of Mines maintains at the Polytechnic School, of Laval University, 228 St. Denis Street, an up-to-date well-equipped laboratory, for the convenience of the interested public. Analyses and assays, determinations of minerals and tests of various ores, samples, and materials found within the boundaries of the Province of Quebec are made in this laboratory at prices which are extremely low for the high-grade work done. The laboratory has been established for the sole purpose of aiding the development of the mineral resources of the Province of Quebec. Prospectors and all persons interested in the Quebec mineral resources are cordially invited to avail themselves of the facilities offered. The tariff in force for the analysis and assay of various substances is given further on, and it will be realized that the fees are very low as the high competence of the chemists ensures results of undoubted reliability.

During the year ending December 31st, 1918, the Provincial Laboratory effected 576 analyses and assays, as follows:

Gold, 76; silver, 32; alumina, 21; arsenic, 5; barite, 1; graphite, (carbon), 35; lime, 29; chrome, 9; copper, 15; iron, 51; magnesite, 28; manganese, 5; molybdenum, 3; nickel, 11; phosphorus, 17; lead, 1; platinum, 3; silica, 56; soda, 2; sulphur, 27; titanium, 14; tungsten, 1; zinc, 2; moisture and combustion, 26; calorific power, 4. Qualitative assays and determinations of minerals, 100.

Province of Quebec.

GOVERNMENT ASSAY LABORATORY

(Under the direction of the Department of Mines of the Province o Quebec as an aid to the development of the mineral resources.)

TARIFF OF FEES FOR ASSAYS AND ANALYSES

DETERMINATIONS	Less than 5 samples Each:	For 5 samples or more Each:
	$ Cts.	$ Cts.
Moisture	0.25	0.25
Combined Water	0.50	0.50
Gold and Silver	1.00	0.90
Silica, Copper, Iron — 1 constituent	1.00	0.90
Silica, Copper, Iron — 2 constituents in same sample	1.75	1.50
Iron, in titaniferous ore	2.00	1.80
Alumina, Cobalt, Graphite, Lead, Lime, Magnesia, Nickel, Sulphur — 1 constituent	1.50	1.35
Alumina, Cobalt, Graphite, Lead, Lime, Magnesia, Nickel, Sulphur — 2 constituents in same sample	2.50	2.25
Antimony, Arsenic, Bismuth, Chromium, Manganese, Molybdenum, Phosphorus, Platinum, Titanium, Zinc — 1 constituent	2.00	1.80
Antimony, Arsenic, Bismuth, Chromium, Manganese, Molybdenum, Phosphorus, Platinum, Titanium, Zinc — 2 constituents in same sample	3.50	3.15
Commercial analysis of an iron ore, comprising determination of silica, iron, phosphorus, titanium and sulphur	6.50	5.85
Commercial analysis of a limestone or cement, comprising silica, lime, iron, alumina, magnesia, and sulphuric acid	6.00	5.40
Commercial analysis (proximate analysis) of a fuel, comprising: ash, volatile combustible, fixed carbon, moisture	3.00	2.70
Calorific power of a fuel	1.50	1.35
Radioactivity of a mineral	1.00	0.90
Radioactivity of a mineral water	2.00	1.80

Determinations of Minerals.—For a nominal fee of 25c. for each sample, the laboratory will make determinations of ores and minerals, provided rapid tests will allow it, and issue a report on probable contents and commercial value of specimens and samples.

Terms.—Money in payment of fees, by registered letter, postal notes or orders, must invariably accompany the samples, in order to insure prompt return of certificate.

Professor E. DULIEUX,
In charge of Laboratory
No. 228 St. Denis St., Montreal.

MINING OPERATIONS

ASBESTOS

Returns of asbestos production were received from thirteen producers who operated eighteen mines during the year ending December 31st, 1918. These producers were:

Asbestos Corporation of Canada Ltd., Thetford Mines, P.Q.
Bell Asbestos Mines, Thetford Mines, P.Q.
Bennett-Martin Asbestos and Chrome Mines Ltd., Coleraine, P.Q.
Black Lake Asbestos and Chrome Co. Ltd., Black Lake, P.Q.
Canadian Johns-Manville Co. Ltd., Asbestos, P.Q.
Eastern Townships Asbestos Co., East Broughton, P.Q.
Federal Asbestos Company, Robertsonville, P.Q.
Jacobs Asbestos Mining Co. of Thetford Ltd., Thetford Mines, P.Q.
Johnson's Company, Thetford Mines, P.Q.
*Frank W. Ross, 92 St. Peter Street, Quebec.
Martin-Bennett Asbestos Mines Ltd., Thetford Mines, P.Q.
Pennington Asbestos Company, Thetford Mines, P.Q.
Quebec Asbestos Corporation, East Broughton, P.Q.

Besides these operations, development work was carried on in four mines and prospects, from which no shipments of asbestos were made.

The asbestos industry was characterized by great activity during the year 1918, as indicated by the figures of production, which show the largest output ever recorded. Both the tonnage and the value of the asbestos produced exceeded all previous records.

Asbestos, in the shape of "crude" and mill-stock was shipped to the amount of 142,375 short tons, to which is to be added 16,850 tons of "asbestic," a by-product of low price, or in all a total tonnage of 159,225. The value of the asbestos proper was $9,019,899, or with the "asbestic," $9,053,945. As compared with the previous year's figures, 154,452 tons valued at $7,240,697, we have an increase of 4,773 tons, or 3.1% in quantity and $1,779,202, or 24.5% in value.

*No mining operations. Shipments from stock on hand.

PRODUCTION OF ASBESTOS IN THE PROVINCE OF QUEBEC IN 1918

DESIGNATION OF GRADE	SHIPMENTS AND SALES		AVERAGE VALUE PER TON	STOCK ON HAND DEC. 31ST 1918	
	TONS	VALUE		TONS	VALUE
Crude No. 1	1,808	$1,695,671	$937.92	1,104	$985,449
Crude No. 2	1,896	805,331	424.74	582	122,399
Mill Stock No. 1	13,559	2,221,954	163.87	2,993	586,$50
Mill Stock No. 2	32,412	1,852,992	57.17	2,522	154,934
Mill Stock No. 3	92,700	2,443,861	26.36	7,033	234,890
	142,375	$9,019,899	63.35	14,234	2,084,522
Asbestic	16,850	34,046	2.02	375	873
Totals	159,225	$9,053,945		14,609	$2,085,395

Quantity of rock mined during the year 1918, 2,445,745 tons.

PRODUCTION OF ASBESTOS IN THE PROVINCE OF QUEBEC FOR 1917.

DESIGNATION OF GRADE	SHIPMENTS AND SALES		AVERAGE VALUE PER TON	STOCK ON HAND DEC. 31ST 1917	
	TONS	VALUE		TONS	VALUE
Crude No. 1	1,761	$1,370,740	$778.38	580	$ 470,923
Crude No. 2	3,603	1,374,387	381.46	746	269,766
Mill Stock No. 1	13,197	1,318,387	99.90	1,089	206,124
Mill Stock No. 2	54,072	1,988,197	36.77	3,346	141,344
Mill Stock No. 3	64,609	1,146,847	17.75	7,447	124,735
Total	137,242	$ 7,198,558	52.45	13,208	1,212,892
Asbestic	17,210	42,139	2.45	263	805
Total	154,452	$7,240,697	.....	13,471	$1,213,697

Quantity of rock mined during the year 1917, 2,634,410 tons.

It is gratifying to note that the tonnage of asbestos produced from the rock mined during the year (taking into account stocks on hand at the end of the year) was 143,401 tons, extracted from 2,445,745 tons of rock, while in 1917 it was 143,174 tons extracted from 2,634,410 tons of rock. This is a yield of 117.3 lbs. of asbestos

per ton in 1918 as compared with 108.7 lbs. in 1917. The contents of the rock in asbestos as depth is reached is, therefore, certainly not decreasing. As to the value of this content the increase is even more marked. For the year 1918 the average value of asbestos extracted from each ton of rock was $4.06. It was $3.08 in 1917, and $2.13 in 1916.

On May 3rd, 1918, an Order-in-Council was passed increasing the royalty collected by the Provincial Government from 2% on the gross value to 3½% on all asbestos produced from the mines in the Province of Quebec after June 1st of that year.

As there is no "standardization" or uniformity in the classification of the grades of asbestos produced by the various companies, the classification which we have adopted to group the various grades and qualities is arbitrarily based on value of the asbestos. Only "Crude No. 1" and "Crude No. 2" are approximately fixed, the former being hand-cobbed asbestos of a length of fiber of three-quarters of an inch and longer, the latter being less than three-quarters of an inch down to five-sixteenths or even one-quarter of an inch. But even these two grades do not represent anything stable, as the prices vary with the proportion of the longer fiber in each.

As to "mill-stock," that is the asbestos separated from the rock by mechanical means, the conditions are infinitely more complex. The length of the asbestos fiber in the rock varies from microscopic to four or five inches.* As mentioned above, all fiber of ⅜ or ½ inch and over is usually hand-cobbed to constitute the "Crude" qualities. The shorter fiber is separated from the rock by milling. The broad principles of the milling practice is to crush the rock, then to put it through specially constructed machinery called "Cyclones," which liberates the fiber and crushes the soft serpentine rock to coarse powder; the rock is eliminated by shaking screens, from the surface of which screens the fiberized or fluffy asbestos is taken up by suction, on the principle of the vacuum cleaner, which is now a common household apparatus. This fiber, of all lengths, is then passed through graders, which are cylindrical screens with arms in the interior revolving in opposite directions. The shorter fiber falls through the meshes of the screen and the longer fiber is discharged as oversize, thus producing various grades according to the size of the mesh of the revolving screen. But in the various mills, not only are the sizes of the meshes of the grading screens not standardized, but the inclination of the axes, the rates at which they

revolve, the number and rate of revolutions of the interior arms vary to such an extent that the products are not comparable and can only be sold by samples or by specified tests. The testing is more uniform, however. The apparatus used consists of a nest of four trays, fitting on top of one another, each 24 inches long, 14 to 16 inches wide and 4 to 5 inches deep. The top tray or No. 1, has a screen bottom of 2 mesh or ½ inch opening, No. 2 screen is ¼ inch or 4 mesh, No. 3 is 1-10 or 10 mesh and the bottom one is a solid tray. The nest is fastened on a frame to which a throw, or horizontal movement, of 1½ inches is given by a shaft and an eccentric.

To make a test, one pound of the asbestos (representing the average of a shipment) is placed on the top screen, and the testing machine is run for a specified time (2 minutes) at the rate of 300 revolutions of the shaft a minute. The fiber retained on each screen and in the bottom tray is weighed separately, which gives the relative proportions of various lengths of fiber. Supposing the specifications of the buyer called for a grade of asbestos 1–6–7–2, it would mean that of the 16 ounce sample he expects at least one ounce to remain on tray No. 1, 6 ounces on tray No. 2 and 7 ounces on tray No. 3.

The industry as a whole would greatly benefit by the establishment of a standard scale of grades. This would enable the buyer to purchase the asbestos he needs without having to refer to samples. But of course such a step can only be taken by the concerted action of all the producers.

The dearth of labour was keenly felt throughout the whole year, and during the fall this situation was further aggravated by the serious epidemic of influenza, which claimed many victims, and for various periods of time some of the mines had practically to shut down.

The "Asbestos Manufacturing Company," who in 1910 built an extensive plant for the manufacture of asbestos products in Lachine, near Montreal, has been reorganized, under the name of "Asbestos Manufacturing Co. Ltd.," with a capital of $1,000,000, and is now producing both for the local trade and for exportation. The president is Hon. P. Paradis, member of the Legislative Council. The factory covers an area of 300,000 square feet, where are manufactured asbestos slates, shingles, sheathing for both interior and exterior use, mill-board, paper, corrugated asbestos sheets and air cell pipe coverings. This is the only manufacturing plant of the kind in Canada. In addition the company sells asbestos fiber, both

crude and millstock. The directors are now considering the installation of an important addition to the plant, for the manufacture of asbestos cloths, asbestos packings and brake bands. The head office of the company is at 17 St. James Street, and the sales office in Drummond Building, St. Catherine Street West, Montreal.

The King mine, of the Asbestos Corporation of Canada, at Thetford, consists now of an open pit, which measures nearly 900 feet in length at the surface, by 500 feet wide, and the deepest point is now 270 feet below the surface. Owing to the scarcity of labour, and also on account of the moving and wet nature of the ground, the inclined tunnel and the shaft under construction for the ingress of the men of the pit, and their egress, are not quite completed. The passage when finished will be 900 feet long, from the portal in the pit to the bottom of the shaft. This shaft which gives access to the tunnel is situated near the public road. It is 75 feet deep, 9 feet in diameter, circular in shape, lined with reinforced concrete, and the men go up and down by a spiral stairway.

At the Beaver mine, of the Asbestos Corporation, some exploratory work was done by means of a calyx drill, and the results are said to have been satisfactory.

At the British Canadian mine of the Asbestos Corporation, at Black Lake, the development work connecting the three pits, of the old British Canadian mine, the Standard mine and the Dominion mine was pushed actively. The tunnels which were begun in 1915 have been completed. The main one, which passes under the British Canadian pit and goes to the Dominion pit, is 1,600 feet long. From a point between these two pits, another tunnel 1,900 feet long branches out to the Standard pit. Steps are being taken to change the old method of working into the "Glory hole" system, hauling the asbestos rock through the tunnel, into a large concrete bin of 25,000 tons near the mouth. This method of working is well adapted to the topography of the ground. The pits are all on higher levels than the bin, which itself is located higher than the mill. This group of workings comprising the three old separate pits now form a single undertaking, with one mill treating the rock from them all, known as the British Canadian mine. Incidentally it may be mentioned that the 3,500 feet of tunnelling, driven in view of adopting the "Glory hole" or "Milling" method of mining have brought to light large quantities of asbestos-bearing rock.

The Fraser mine, at East Broughton, which was reopened by the Asbestos Corporation in 1917, worked and produced steadily all year. The mill, which was constructed during the latter part of 1917, was put in operation in December of that year and has been running without interruption since then.

At the Jacobs mine, Thetford, the "Glory hole" method of working was begun in August and at present about 600 tons a day is hoisted by the shaft. The balance of the mill-feed is derived from the open pit, now 206 feet deep and is hoisted by the cable derricks. These, however, will eventually be abandoned.

The shaft is a three compartment one, 515 feet deep. At 188 feet a level has been driven, 1,400 feet long from which cross-cuts branch off, in which the "Glory hole" chutes discharge. The haulage in the cross-cuts is by steel cars and horses to the main tunnel, in which the trains are hauled by a storage electric locomotive to the loading pocket at the shaft.

The raises from the cross-cuts to the surface are vertical for the upper 100 feet or so. The lower parts, for 20 to 30 feet, are made into chutes inclined at 45°, discharging into the mine cars.

The shaft has been sunk to 514 feet to provide for another level, 175 feet below the first one, and a loading station. The hoisting plant of the shaft has a capacity of 2,000 tons of rock per day.

In the Danville district, at the Jeffrey mine of the Canadian Johns-Manville Asbestos Company, a new reorganization of the Asbestos & Asbestic Company, the elimination of the cable derrick system of hoisting the rock has been completed, and at present only one of these machines remains, which is used exclusively for conveying supplies and tools. All the old cable derricks have been replaced by four steam-shovels, which load the broken rock into cars of standard gauge at the bottom of the pit and on the benches. These cars, made into trains, are hauled to the mill by steam locomotives.

The Bennett-Martin Asbestos and Chrome Mines, Ltd., control the mining rights on the majority of the lots between 20 and 28 ranges I to V of the township of Ireland. This company, organized in 1917, has been very active and progressive. The mine, or quarry, is situated on the side of an eminence, or hill, to which has been given the name of Vimy Ridge, on lot 25, range III of Ireland. The mill and shops are on both lots 24 and 25. The floor of the quarry

is on the same level as the top floor of the mill. The loaded mine cars are made into trains and hauled to the mill by a small locomotive. The asbestos rock is dumped into a bin which feeds the crusher and the cars of lean rock go on to the end of the trestle, and are dumped on the side of the hill, which is fifty or sixty feet below. The asbestos of Vimy Ridge is in a typical ribbon structure rock, which as a rule, is very rich. Some parts of the rock contain as much as 30% of fiber, of which a comparatively high proportion would grade as No. 1 mill-stock. The activity which has prevailed in this camp may be gathered from the fact that in less than a year the mine has been opened, six miles of road have been built, the mill treating 700 tons a day has been constructed, besides a saw mill, blacksmith, machine, carpenter shops, and the camp buildings for the men. The mill was started on July 24th and the first shipment of fiber was effected on August 2nd, 1918.

The Vimy Ridge mine is situated six miles from Coleraine station, and the hauling of the asbestos has been done so far by teams, but the road is to be concreted and motor trucks used at an early date.

At Robertson, the old Robertson Asbestos Company, which was organized in 1916 under the name of Regent Asbestos Company, but did not work the mine which is situated on lot 16, range IV of Thetford township, was taken over by the Pennington Asbestos Company, and work started again in June 1918. The mill, which has a capacity of 1,000 tons of rock a day, was overhauled and modernized and very substantial shipments of asbestos were made during the latter part of the year.

In the East Broughton district, apart from the Fraser mine of the Asbestos Corporation and of the mine of Quebec Asbestos Corporation which worked and produced steadily throughout the year, operations were resumed on the property of Eastern Townships Asbestos Co., on lot 13, range VI, township of Broughton. This is being operated on trial and under option, by a New York group. The mine was reopened in July and some shipments were made during the fall. In December the mining operations were discontinued, but the mill was being altered and enlarged, and it was expected that the mine and mill would again start in May.

The Quebec Asbestos Corporation, at East Broughton, has made extensive alterations in its mill, which now has a feed capacity of 1,000 tons of rock per day.

It is interesting to note that asbestos, of short fiber, has been discovered in Talon township, county of Montmagny, on a claim which comprises the North half of lots 8 to 11 of range VI. This occurrence is a link in the "serpentine belt," which extends, with gaps, from the Vermont boundary to Gaspé peninsula, one of its most eastern outcroppings being the Mont Albert massif, in the county of Gaspé.

It may be mentioned that as far back as 1908, in the summary report of the Geological Survey of that year, J. A. Dresser, who did some geological field-work in that region makes the remark: "the diabase-serpentine areas promise to become more important . . . . In Range V of Talon, in the county of Montmagny, there is a considerable body of serpentine, probably one mile in width. Asbestos of short fiber was seen in it, but no detailed examination could be made in the time at our disposal. The country is heavily wooded making the extent of this igneous belt difficult to determine; but the area that it seems most important to prospect, is one about 12 miles long, 2 or 3 miles in width, lying largely between the l'Islet and the Montmagny roads. This is chiefly in ranges V and VI of Rolette; III, IV and V of Talon, and I and II of Leverrier.

"Besides this, there is a series of detached hills, continuing in the same general trend for 15 miles further to the South West, in the vicinity of St. Fabien and St. Magloire."

Another discovery of asbestos was reported some time ago from Gaboury township, east of Ville-Marie, south of the township of Latulippe, in the Lake Temiscamingue district. The deposits are situated north of a small lake, designated on the maps as Lake McKenzie, in the unsurveyed part of the township. The work done there during the summer of 1918 seems to have revealed the presence of important deposits. Some samples of this asbestos, sent to the Bureau of Mines during the winter, compare well with the Thetford material for silkiness and colour. It is chrysotile-asbestos and some of the cross fiber, of good quality, attains lengths of one inch.

The deposits are reported to occur on a ridge of dark rock, some 2½ miles long and half a mile wide. The location is easy of access, as a very good road is built within five miles of the deposits. It is the intention of the Bureau of Mines to examine this district at an early date.

The Asbestos deposits of the Province of Quebec, which at present supply between 85 and 90 per cent of the world's consump-

tion of this substance, are situated in a band or zone of igneous rocks, which, beginning in Vermont, enters Canada near lake Memphramagog, crosses the Eastern Townships in a north-easterly trend and extends, with gaps, as far east as Gaspé peninsula, where Mount Albert is one of the last outcrops known in Canada. This is known as the "Serpentine Belt," although serpentinized rocks only constitute a very small proportion of this system of intrusions. But from an economic standpoint the areas of serpentine are the important members of the series, as they contain the asbestos deposits.

The igneous rocks of the serpentine series consist of peridotites, dunites, pyroxenites, gabbros, diabases, granites, aplite, serpentines and talcose schists. The serpentine results from the alteration of the dunites and peridotites and it is in this altered rock that are found the asbestos veins. As to the general geological structure of the region it may be said to present a broad anticlinal fold, having a core of precambrian rocks, mainly quartzites, flanked on each side by Cambrian sediments, quartzose schists and grey-greenish quartzites of l'Islet formation, followed by ordovician shales and slates. As to the age of the intrusions, it is post-ordovician, for the igneous rocks cut all the sedimentary formations of this region.

There are now six producing centres of asbestos, the most northern one of which is East Broughton, situated sixty miles south of Quebec City; Robertson, ten miles further south, followed by Thetford Mines, Black Lake and Coleraine, all on the line of the Quebec Central Railway which joins Quebec to Sherbrooke. The sixth centre is at Danville, eighty miles south-west of Quebec, on the Grand Trunk Railway.

ASBESTOS IN OTHER COUNTRIES

**United States*—In the United States, chrysotile asbestos is produced in three States: Arizona, California and Wyoming. Hornblende asbestos is produced in Georgia, Maryland and Virginia. By far the greater portion of the total production of asbestos of the United States comes from two localities in Arizona, the principal one being at Ash Creek, some 28 miles, in an air line, and 42 miles by road, to the north-east of Globe; the second one is on Mount Baker, in the southern part of the Sierra Ancha, some thirty-five miles in an air line, to the north-west of Globe.

*See J. S. Diller Mineral Resources, United States 1917.

In the first of these localities operations are being carried on by the American Ores and Asbestos Company, while in the Ash Creek district the operators are H. W. Johns-Manville Co.; Penn Asbestos Mining and Refining Company; the Colorado-Arizona Asbestos Company; other properties were prospected.

In Wyoming a mine is operated by the American Fireproofing and Mining Company, twenty-eight miles south of Lander.

In California two companies are producing, the John D. Hoff Asbestos Company, of Oakland, and the Sierra Asbestos Company of Washington, California, operating in Nevada county and in Tuyo county.

The other states mentioned, Georgia, Maryland and Virginia, produce only amphibole asbestos, or "slip-fiber," which is brittle, weak, and the uses and applications of which are very limited.

The figures of production of asbestos in the United States for 1918 are not yet available, but in 1917, according to the United States Geological Survey, they were 1,683 short tons, valued at $506,056, or an average of $301 a ton. This high value comes from the fact that the greater part of the asbestos is long fiber; the mines of Ash Creek, Arizona, being situated forty-two miles from the railroad, only high-priced fiber can stand the cost of hauling.

Southern Rhodesia.—In all probability South Rhodesia is now the second largest asbestos producing country in the world, ranking after Canada. No statistics have been available from Russia since 1914, but all indicates that the importance of the Urals asbestos industry is only a fraction of what it was before the war.

The figures of production of asbestos in Southern Rhodesia for the year ending December 1918 were 8,574 tons, valued at $761,683. This is a decrease as compared with 1917, when 9,563 tons, valued at $925,714 were produced.

The main asbestos quarries of South Rhodesia are situated in the north-eastern corner of the Mashala mountains, on the road between Selukwe and Victoria. The asbestos is chrysotile, of a white colour and of comparatively good quality, although more brittle and less silky than the Quebec asbestos.

Union of South Africa—Cape Province.—The Cape asbestos is crocidolite, or "blue asbestos," an amphibole variety, of dark blueish lavender colour, strong fibre, but less resisting to heat than

the chrysotile-asbestos. The production of Cape asbestos increased from 2138 tons, valued at £35,899 in 1915, to 4,228 tons, valued at £74,293, in 1916, but the figures for 1917 fell back to 2,999 tons, valued at £49,485.

Owing to its different characteristics and qualities the Cape asbestos cannot be said to be a competitor of Quebec asbestos, and the fluctuations in the figures of production seem to indicate an irregular and spasmodic demand.

The Cape asbestos deposits occur in the Asbestos Mountains, in the northern part of the Province of Cape of Good Hope, and in Bechuanaland, in the districts of Preiska, Hay and Kuruman.

Transvaal.—In the Transvaal the asbestos industry appears to have made great progress in the last two years. The figures of production for 1918 are not yet available, but in 1917 some 3,193 tons, valued at £37,486, were shipped and sold, as compared with 407 tons, valued at £8,490, for the year 1916.

Occurrences of asbestos had been known for some time in the Carolina district in the eastern part of Transvaal, but they were never developed to any extent. The following note, in the annual report of the Government mining engineer for the Union of South Africa, for the year 1917, seems to indicate that some important new discoveries were made to the north of the known occurrences.

The extract is from the report of T. G. Trevor, in charge of the Pretoria inspectorate:—

"This district (Lydenburg district) has provided the most "sensational development of mining of the year. The asbestos "mines of Penge and the neighbouring farms have been developed "most successfully, and the deposits appear to be larger than any "others known in the world.

"An output of 500 tons a month was obtained and would have "been maintained indefinitely but for the heavy rains which have "rendered transport quite impracticable.

"This asbestos industry may go a long way towards replacing "the simple free-milling gold-mining of the past, which, as before "remarked, is gradually coming to an end."

In connection with the above development it may be mentioned that Dr. Percy A. Wagner in an article contributed to the South

African Journal of Industries, November 1917, describes the Lydenburg occurrence as follows:

"As regards occurrences of iron-amphibole asbestos, an asbestos "field of exceptional promise has been opened up during the past "two years in the northern portion of the Lydenburg district "of the Transvaal, the asbestos occurring in bedded veins in ferri- "ginous shales belonging to the basal portion of the Pretoria series, "at a slightly lower horizon than the Griqualand West deposits. The "deposits have not as yet been accurately delimited, but appear to "be of very great extent. The mineral was first discovered on the "Farm Penge, situated about 50 miles North of Lydenburg. At the "present time operations are confined to Penge and the adjoining "farm Streatham. These farms are situated in the valley of the "Olifant's river, where the latter breaks through the Drakensberg. "The area is mountainous and rugged and very inaccessible. The "distance by road to Lydenburg, the nearest point on the railway, "was originally 75 miles, but this has been reduced to 65 miles by "the construction of a more direct road. The asbestos is found in "long irregular lenses up to 12 inches in thickness that overlap in "such a manner as to form practically continuous layers extending "over hundreds of yards. The lenses conform to the stratification "of the enclosing rocks.

"The pale greenish fibre from the lower workings on Penge is at "present being shipped in considerable quantities to Japan and the "United States. It appears by reason of its length and great tensile "strength to be admirably adapted for the manufacture of asbestos "rope and textiles, and as no other field is capable of producing "fibre of this length in such large quantities, there can be no question "that the mineral is going to play a very important rôle in the "asbestos manufacturing industry. The precise mineralogical com- "position of the fibre has not as yet been determined. It is un- "doubtedly amphibole asbestos, apparently monoclinic with a very "small angle of extinction. It differs from tremolite and actinolite "in containing up to 37% of ferrous oxide; from crocidolite in being "apparently quite free from soda; and from all these minerals in "containing up to 9.3% of alumina. The various analyses so far "made are difficult to reconcile."

CHROMITE

In spite of the keen demand for chromite during the first half of the year and the consequent increase in prices, the tonnage produced in the Coleraine-Black Lake district is rather less than for 1917.

Returns of production of chromite were received from nine producers, the total quantity being 36,131 short tons, valued at $770,955. This, however, it may be explained comprises both the so-called "crude ore," that is ore in lumps, sufficiently rich to be shipped direct from the mine without concentrating, and low grade ore, below 30% of sesquioxide of chrome, which required treatment in the local mills. The quantity of chromite shipped from the district, of crude and concentrates, was actually in the vicinity of 21,500 tons. In 1917, the quantity produced had been 36,186 tons valued at $498,031, which previous to shipping had been reduced to "crude" and concentrates of a tonnage of about 23,000 tons.

As to value, the year 1918 constitutes a record which will not be reached again for a long time, unless some new unexpected sources come to light. As explained in last year's report, the world's usual sources of supply of chromite, Rhodesia and New Caledonia, were practically cut off as far as America was concerned, owing to the lack of ocean shipping space. The United States and Canada had to develop their own resources in that mineral to supply their needs, which an estimate had put at 160,000 tons for the year 1918. An appeal was made to all owners of chromite deposits to do all they could to produce as much as possible. In consequence the prices rose gradually until in May and June the quotations were $1.50 to $1.55 a unit for 45% ore with variations of 5c. a unit for grades above or below that standard. These prices were F. O. B. at shipping points. In the United States transactions were recorded at $100 a ton for 50% ore. By September the prices had eased off considerably to $1.40 and less, while in October the market could not absorb the supply. On the news of the signing of the armistice, the bottom practically dropped out of the chrome market, and at the end of the year only the operators having contracts to fill at prices which permitted to make ends meet were working. At present, in March 1919, only two operators are producing. It may be stated in a general way, that under the present conditions, chrome mining to be remunerative in the Province of Quebec requires a market price of 80c. to $1.00 a unit for 45% shipping ore or concentrates.

OPERATORS IN 1918

The *Quebec Asbestos & Chrome Company* worked very actively the chrome deposit which was opened during the latter part of 1916 by Mr. Douglas B. Sterrett, on lots 7 and 8, range X of Cleveland township, near Danville. The ore was produced mostly from open cuts, but during the year a shaft 196 feet deep was sunk. This is a two compartment shaft, 4 ft. 8 in. by 8 ft., well timbered, the timbering being reinforced with steel rods. From the shaft two cross-cuts have been driven, one, the first level, at 109 feet from the shaft collar, the other 75 feet lower.

The cross-cut at the first level was driven 191 feet, cutting one good vein 67 feet from the shaft. On this vein a drift has been opened, following the ore 100 ft. towards the south and 75 feet towards the north. Towards the south, the lens practically pinches out, but at the end of the year the north drift was still in ore.

On the second level a cross-cut has been driven for 74 feet. A little ore has been revealed.

In April 1918, the Quebec Asbestos & Chrome Company purchased from the Mutual Chemical Company the new mill which had been built on lot 7, range B, of Coleraine, to treat the ore of the old mines of the American Chrome Company, near little Lake St. Francis, mentioned in our report for 1917. This mill, both the machinery and the building, were moved to the property of the Quebec Asbestos and Chrome Company, at St. Cyr, and was put in operation in the early part of November. The machinery consists of a Blake crusher, a Hardinge mill, 6 feet by 22 inches, a standard Duplex Dorr classifier, a Dorr Thickener, a Duplex Callow screen, seven Wilfley tables and three Diester-Overstrom tables. The power is electric, a 60 H.P. motor for the Hardinge mill, a 30 H.P. for the Blake crusher and bucket elevators and a 15 H.P. for the other machines. The mill feed is eighty tons of ore a day. The property closed down in March 1919.

The *Mutual Chemical Company*, during the early part of the year, acquired, first by option then by purchase, the Lake Caribou Mine, on lot 19 N.W. range X of Coleraine township, from the Reed Estate, which is administered by the Royal Trust Company. Work was carried on continuously. A vertical shaft, located sixty feet from the workings, has been sunk to 122 feet, and the intention is to carry it down to 200 feet. A first level was driven towards the old open

pit, under which it passes. While the shaft was being sunk, mining was carried on in the open workings. In February the shaft was hoisting ore which is hauled to the company's mills, a short description of which was given in our last year's report. This is the mill of the Black Lake Asbestos and Chrome Company, which is leased by the Mutual Chemical Company of Canada, and which has been much improved by them.

This mill has also purchased ore from other sources, and has acted as a custom mill throughout the year. They have purchased ore as low as 8% chromite. In July the scale of prices paid for various grades was as follows:—8% ore, $2.10 a ton; 16% ore, $5.50; 20% ore, $7.15; 30% ore, $13.45.

Mr. J. V. Belanger, during the first part of the year, operated on lot 19 N.W. range X of Coleraine, until this property was acquired by the Mutual Chemical of Canada. The chromite deposit crosses the boundary line separating lot 19 N.W. from lot 19 S.E., and extends into the latter. Mr. Belanger's mill is located on No. 19 S.E., close to the boundary line, and he purchased the lot from the owners, the King-Chapleau Estate, and transferred his mining operations to this lot. A very good deposit of chromite has been brought to light and Mr. Belanger was one of the important shippers of chromite during the year. The new workings are in open cuts, but in November a shaft was started and in February this was down 30 feet. The mill has been enlarged and now consists, in the main, of fifteen stamps and four tables. While the recovery in concentrates is not very high, probably 65% on 15% ore, the results are satisfactory owing to the proximity of the mill, which is near the mine, and to the cheapness of operating the concentrator. Moreover, the upper part of the new deposit, which constitutes the extension of the Caribou Lake Mine deposit, is decomposed to the extent that the ore can be loosened by pick and shovelled into wagons, which haul it a couple of hundred feet to the mill.

This deposit on lots 19 N.W. and S.E. is irregular, but consists mainly of disseminated chromite, constituting milling ore, in a zone 100 feet wide by 1400 feet long. On either side of this zone small pockets of rich shipping ore occur.*

The deposits of the "Montreal Pit" on lots 25 and 26 range II., and those of the old Canadian Chrome Company, on lot 16, range

*Harvie. Eng. and Mining Journal, Vol. 107—No. 3.

"A" of Coleraine, were worked by contract for the *Dominion Mines and Quarries Ltd.* The ore obtained was practically all shipped as low-grade crude ore, without concentration.

The *Bennett-Martin Asbestos and Chrome Mines Ltd.*, carried on work on lots 25 and 28, range II. of Ireland township, and made substantial shipments of crude ore.

The *Black Lake Asbestos and Chrome Company*, the owners of blocks "A" and "B" of the township of Coleraine, two very large blocks containing some 6,000 acres, extracted chromite from various pits and deposits on their property, but all the work was done by contract. In the latter part of the year the company started a shaft at the Caribou Mine, on block "A," near Caribou Lake.

In addition to the above, reports were received, of work done during the year, on the following lots, and in some cases small shipments of chromite were effected:—

Coleraine township, lot 18, range "A"; lot 14, range "B."

Wolfestown township, lot 23, range III.

Garthby township, lots "B" and "C," range I., lots 5, 6, 7, 8, range II.

Broughton township, lot 26, range IX.

It may be mentioned that, at the request of the United States Government, the Canadian War Trade Board undertook to stimulate the production of chrome to meet an anticipated shortage due to restrictions then being placed on imports from overseas. Such restrictions had become necessary owing to shortage of ocean freight, all available boats having been put on the routes to France and England. Dr. Robert Harvie, the geologist in charge of the district for the Federal Department of Mines, was appointed in March 1918, as representative of the War Trade Board, and established his headquarters at Black Lake. The policy followed to attain an increased production was to improve existing facilities and to give direct assistance when possible, such as speedy granting of export and import licenses; the waiving of express regulations to facilitate delivery of machinery; obtaining military exemptions for skilled employees; improvement in freight-car service.

In an article to the Engineering and Mining Journal, Dr.

MINING OPERATIONS

ASBESTOS

Returns of asbestos production were received from thirteen producers who operated eighteen mines during the year ending December 31st, 1918. These producers were:

Asbestos Corporation of Canada Ltd., Thetford Mines, P.Q.
Bell Asbestos Mines, Thetford Mines, P.Q.
Bennett-Martin Asbestos and Chrome Mines Ltd., Coleraine, P.Q.
Black Lake Asbestos and Chrome Co. Ltd., Black Lake, P.Q.
Canadian Johns-Manville Co. Ltd., Asbestos, P.Q.
Eastern Townships Asbestos Co., East Broughton, P.Q.
Federal Asbestos Company, Robertsonville, P.Q.
Jacobs Asbestos Mining Co. of Thetford Ltd., Thetford Mines, P.Q.
Johnson's Company, Thetford Mines, P.Q.
*Frank W. Ross, 92 St. Peter Street, Quebec.
Martin-Bennett Asbestos Mines Ltd., Thetford Mines, P.Q.
Pennington Asbestos Company, Thetford Mines, P.Q.
Quebec Asbestos Corporation, East Broughton, P.Q.

Besides these operations, development work was carried on in four mines and prospects, from which no shipments of asbestos were made.

The asbestos industry was characterized by great activity during the year 1918, as indicated by the figures of production, which show the largest output ever recorded. Both the tonnage and the value of the asbestos produced exceeded all previous records.

Asbestos, in the shape of "crude" and mill-stock was shipped to the amount of 142,375 short tons, to which is to be added 16,850 tons of "asbestic," a by-product of low price, or in all a total tonnage of 159,225. The value of the asbestos proper was $9,019,899, or with the "asbestic," $9,053,945. As compared with the previous year's figures, 154,452 tons valued at $7,240,697, we have an increase of 4,773 tons, or 3.1% in quantity and $1,779,202, or 24.5% in value.

*No mining operations. Shipments from stock on hand.

PRODUCTION OF ASBESTOS IN THE PROVINCE OF QUEBEC IN 1918

DESIGNATION OF GRADE	SHIPMENTS AND SALES		AVERAGE VALUE PER TON	STOCK ON HAND DEC. 31ST 1918	
	TONS	VALUE		TONS	VALUE
Crude No. 1	1,808	$1,695,671	$937.92	1,104	$985,449
Crude No. 2	1,896	805,331	424.74	582	122,399
Mill Stock No. 1	13,559	2,221,954	163.87	2,993	586,$50
Mill Stock No. 2	32,412	1,852,992	57.17	2,522	154,934
Mill Stock No. 3	92,700	2,443,861	26.36	7,033	234,890
	142,375	$9,019,899	63.35	14,234	2,084,522
Asbestic	16,850	34,046	2.02	375	873
Totals	159,225	$9,053,945		14,609	$2,085,395

Quantity of rock mined during the year 1918, 2,445,745 tons.

PRODUCTION OF ASBESTOS IN THE PROVINCE OF QUEBEC FOR 1917.

DESIGNATION OF GRADE	SHIPMENTS AND SALES		AVERAGE VALUE PER TON	STOCK ON HAND DEC. 31ST 1917	
	TONS	VALUE		TONS	VALUE
Crude No. 1	1,761	$1,370,740	$778.38	580	$ 470,923
Crude No. 2	3,603	1,374,387	381.46	746	269,766
Mill Stock No. 1	13,197	1,318,387	99.90	1,089	206,124
Mill Stock No. 2	54,072	1,988,197	36.77	3,346	141,344
Mill Stock No. 3	64,609	1,146,847	17.75	7,447	124,735
Total	137,242	$ 7,198,558	52.45	13,208	1,212,892
Asbestic	17,210	42,139	2.45	263	805
Total	154,452	$7,240,697	.....	13,471	$1,213,697

Quantity of rock mined during the year 1917, 2,634,410 tons.

It is gratifying to note that the tonnage of asbestos produced from the rock mined during the year (taking into account stocks on hand at the end of the year) was 143,401 tons, extracted from 2,445,745 tons of rock, while in 1917 it was 143,174 tons extracted from 2,634,410 tons of rock. This is a yield of 117.3 lbs. of asbestos

per ton in 1918 as compared with 108.7 lbs. in 1917. The contents of the rock in asbestos as depth is reached is, therefore, certainly not decreasing. As to the value of this content the increase is even more marked. For the year 1918 the average value of asbestos extracted from each ton of rock was $4.06. It was $3.08 in 1917, and $2.13 in 1916.

On May 3rd, 1918, an Order-in-Council was passed increasing the royalty collected by the Provincial Government from 2% on the gross value to 3½% on all asbestos produced from the mines in the Province of Quebec after June 1st of that year.

As there is no "standardization" or uniformity in the classification of the grades of asbestos produced by the various companies, the classification which we have adopted to group the various grades and qualities is arbitrarily based on value of the asbestos. Only "Crude No. 1" and "Crude No. 2" are approximately fixed, the former being hand-cobbed asbestos of a length of fiber of three-quarters of an inch and longer, the latter being less than three-quarters of an inch down to five-sixteenths or even one-quarter of an inch. But even these two grades do not represent anything stable, as the prices vary with the proportion of the longer fiber in each.

As to "mill-stock," that is the asbestos separated from the rock by mechanical means, the conditions are infinitely more complex. The length of the asbestos fiber in the rock varies from microscopic to four or five inches. As mentioned above, all fiber of ⅜ or ½ inch and over is usually hand-cobbed to constitute the "Crude" qualities. The shorter fiber is separated from the rock by milling. The broad principles of the milling practice is to crush the rock, then to put it through specially constructed machinery called "Cyclones," which liberates the fiber and crushes the soft serpentine rock to coarse powder; the rock is eliminated by shaking screens, from the surface of which screens the fiberized or fluffy asbestos is taken up by suction, on the principle of the vacuum cleaner, which is now a common household apparatus. This fiber, of all lengths, is then passed through graders, which are cylindrical screens with arms in the interior revolving in opposite directions. The shorter fiber falls through the meshes of the screen and the longer fiber is discharged as oversize, thus producing various grades according to the size of the mesh of the revolving screen. But in the various mills, not only are the sizes of the meshes of the grading screens not standardized, but the inclination of the axes, the rates at which they

revolve, the number and rate of revolutions of the interior arms vary to such an extent that the products are not comparable and can only be sold by samples or by specified tests. The testing is more uniform, however. The apparatus used consists of a nest of four trays, fitting on top of one another, each 24 inches long, 14 to 16 inches wide and 4 to 5 inches deep. The top tray or No. 1, has a screen bottom of 2 mesh or ½ inch opening, No. 2 screen is ¼ inch or 4 mesh, No. 3 is 1-10 or 10 mesh and the bottom one is a solid tray. The nest is fastened on a frame to which a throw, or horizontal movement, of 1½ inches is given by a shaft and an eccentric.

To make a test, one pound of the asbestos (representing the average of a shipment) is placed on the top screen, and the testing machine is run for a specified time (2 minutes) at the rate of 300 revolutions of the shaft a minute. The fiber retained on each screen and in the bottom tray is weighed separately, which gives the relative proportions of various lengths of fiber. Supposing the specifications of the buyer called for a grade of asbestos 1–6–7–2, it would mean that of the 16 ounce sample he expects at least one ounce to remain on tray No. 1, 6 ounces on tray No. 2 and 7 ounces on tray No. 3.

The industry as a whole would greatly benefit by the establishment of a standard scale of grades. This would enable the buyer to purchase the asbestos he needs without having to refer to samples. But of course such a step can only be taken by the concerted action of all the producers.

The dearth of labour was keenly felt throughout the whole year, and during the fall this situation was further aggravated by the serious epidemic of influenza, which claimed many victims, and for various periods of time some of the mines had practically to shut down.

The "Asbestos Manufacturing Company," who in 1910 built an extensive plant for the manufacture of asbestos products in Lachine, near Montreal, has been reorganized, under the name of "Asbestos Manufacturing Co. Ltd.," with a capital of $1,000,000, and is now producing both for the local trade and for exportation. The president is Hon. P. Paradis, member of the Legislative Council. The factory covers an area of 300,000 square feet, where are manufactured asbestos slates, shingles, sheathing for both interior and exterior use, mill-board, paper, corrugated asbestos sheets and air cell pipe coverings. This is the only manufacturing plant of the kind in Canada. In addition the company sells asbestos fiber, both

crude and millstock. The directors are now considering the installation of an important addition to the plant, for the manufacture of asbestos cloths, asbestos packings and brake bands. The head office of the company is at 17 St. James Street, and the sales office in Drummond Building, St. Catherine Street West, Montreal.

The King mine, of the Asbestos Corporation of Canada, at Thetford, consists now of an open pit, which measures nearly 900 feet in length at the surface, by 500 feet wide, and the deepest point is now 270 feet below the surface. Owing to the scarcity of labour, and also on account of the moving and wet nature of the ground, the inclined tunnel and the shaft under construction for the ingress of the men of the pit, and their egress, are not quite completed. The passage when finished will be 900 feet long, from the portal in the pit to the bottom of the shaft. This shaft which gives access to the tunnel is situated near the public road. It is 75 feet deep, 9 feet in diameter, circular in shape, lined with reinforced concrete, and the men go up and down by a spiral stairway.

At the Beaver mine, of the Asbestos Corporation, some exploratory work was done by means of a calyx drill, and the results are said to have been satisfactory.

At the British Canadian mine of the Asbestos Corporation, at Black Lake, the development work connecting the three pits, of the old British Canadian mine, the Standard mine and the Dominion mine was pushed actively. The tunnels which were begun in 1915 have been completed. The main one, which passes under the British Canadian pit and goes to the Dominion pit, is 1,600 feet long. From a point between these two pits, another tunnel 1,900 feet long branches out to the Standard pit. Steps are being taken to change the old method of working into the "Glory hole" system, hauling the asbestos rock through the tunnel, into a large concrete bin of 25,000 tons near the mouth. This method of working is well adapted to the topography of the ground. The pits are all on higher levels than the bin, which itself is located higher than the mill. This group of workings comprising the three old separate pits now form a single undertaking, with one mill treating the rock from them all, known as the British Canadian mine. Incidentally it may be mentioned that the 3,500 feet of tunnelling, driven in view of adopting the "Glory hole" or "Milling" method of mining have brought to light large quantities of asbestos-bearing rock.

The Fraser mine, at East Broughton, which was reopened by the Asbestos Corporation in 1917, worked and produced steadily all year. The mill, which was constructed during the latter part of 1917, was put in operation in December of that year and has been running without interruption since then.

At the Jacobs mine, Thetford, the "Glory hole" method of working was begun in August and at present about 600 tons a day is hoisted by the shaft. The balance of the mill-feed is derived from the open pit, now 206 feet deep and is hoisted by the cable derricks. These, however, will eventually be abandoned.

The shaft is a three compartment one, 515 feet deep. At 188 feet a level has been driven, 1,400 feet long from which cross-cuts branch off, in which the "Glory hole" chutes discharge. The haulage in the cross-cuts is by steel cars and horses to the main tunnel, in which the trains are hauled by a storage electric locomotive to the loading pocket at the shaft.

The raises from the cross-cuts to the surface are vertical for the upper 100 feet or so. The lower parts, for 20 to 30 feet, are made into chutes inclined at 45°, discharging into the mine cars.

The shaft has been sunk to 514 feet to provide for another level, 175 feet below the first one, and a loading station. The hoisting plant of the shaft has a capacity of 2,000 tons of rock per day.

In the Danville district, at the Jeffrey mine of the Canadian Johns-Manville Asbestos Company, a new reorganization of the Asbestos & Asbestic Company, the elimination of the cable derrick system of hoisting the rock has been completed, and at present only one of these machines remains, which is used exclusively for conveying supplies and tools. All the old cable derricks have been replaced by four steam-shovels, which load the broken rock into cars of standard gauge at the bottom of the pit and on the benches. These cars, made into trains, are hauled to the mill by steam locomotives.

The Bennett-Martin Asbestos and Chrome Mines, Ltd., control the mining rights on the majority of the lots between 20 and 28 ranges I to V of the township of Ireland. This company, organized in 1917, has been very active and progressive. The mine, or quarry, is situated on the side of an eminence, or hill, to which has been given the name of Vimy Ridge, on lot 25, range III of Ireland. The mill and shops are on both lots 24 and 25. The floor of the quarry

Federal Asbestos Company, Robertson, Que.—Mine and Mill.

Bennett-Martin Asbestos and Chrome Mines Ltd.—Vimy Ridge Mill, Ireland Township, Que.

is on the same level as the top floor of the mill. The loaded mine cars are made into trains and hauled to the mill by a small locomotive. The asbestos rock is dumped into a bin which feeds the crusher and the cars of lean rock go on to the end of the trestle, and are dumped on the side of the hill, which is fifty or sixty feet below. The asbestos of Vimy Ridge is in a typical ribbon structure rock, which as a rule, is very rich. Some parts of the rock contain as much as 30% of fiber, of which a comparatively high proportion would grade as No. 1 mill-stock. The activity which has prevailed in this camp may be gathered from the fact that in less than a year the mine has been opened, six miles of road have been built, the mill treating 700 tons a day has been constructed, besides a saw mill, blacksmith, machine, carpenter shops, and the camp buildings for the men. The mill was started on July 24th and the first shipment of fiber was effected on August 2nd, 1918.

The Vimy Ridge mine is situated six miles from Coleraine station, and the hauling of the asbestos has been done so far by teams, but the road is to be concreted and motor trucks used at an early date.

At Robertson, the old Robertson Asbestos Company, which was organized in 1916 under the name of Regent Asbestos Company, but did not work the mine which is situated on lot 16, range IV of Thetford township, was taken over by the Pennington Asbestos Company, and work started again in June 1918. The mill, which has a capacity of 1,000 tons of rock a day, was overhauled and modernized and very substantial shipments of asbestos were made during the latter part of the year.

In the East Broughton district, apart from the Fraser mine of the Asbestos Corporation and of the mine of Quebec Asbestos Corporation which worked and produced steadily throughout the year, operations were resumed on the property of Eastern Townships Asbestos Co., on lot 13, range VI, township of Broughton. This is being operated on trial and under option, by a New York group. The mine was reopened in July and some shipments were made during the fall. In December the mining operations were discontinued, but the mill was being altered and enlarged, and it was expected that the mine and mill would again start in May.

The Quebec Asbestos Corporation, at East Broughton, has made extensive alterations in its mill, which now has a feed capacity of 1,000 tons of rock per day.

It is interesting to note that asbestos, of short fiber, has been discovered in Talon township, county of Montmagny, on a claim which comprises the North half of lots 8 to 11 of range VI. This occurrence is a link in the "serpentine belt," which extends, with gaps, from the Vermont boundary to Gaspé peninsula, one of its most eastern outcroppings being the Mont Albert massif, in the county of Gaspé.

It may be mentioned that as far back as 1908, in the summary report of the Geological Survey of that year, J. A. Dresser, who did some geological field-work in that region makes the remark: "the diabase-serpentine areas promise to become more important . . . . In Range V of Talon, in the county of Montmagny, there is a considerable body of serpentine, probably one mile in width. Asbestos of short fiber was seen in it, but no detailed examination could be made in the time at our disposal. The country is heavily wooded making the extent of this igneous belt difficult to determine; but the area that it seems most important to prospect, is one about 12 miles long, 2 or 3 miles in width, lying largely between the l'Islet and the Montmagny roads. This is chiefly in ranges V and VI of Rolette; III, IV and V of Talon, and I and II of Leverrier.

"Besides this, there is a series of detached hills, continuing in the same general trend for 15 miles further to the South West, in the vicinity of St. Fabien and St. Magloire."

Another discovery of asbestos was reported some time ago from Gaboury township, east of Ville-Marie, south of the township of Latulippe, in the Lake Temiscamingue district. The deposits are situated north of a small lake, designated on the maps as Lake McKenzie, in the unsurveyed part of the township. The work done there during the summer of 1918 seems to have revealed the presence of important deposits. Some samples of this asbestos, sent to the Bureau of Mines during the winter, compare well with the Thetford material for silkiness and colour. It is chrysotile-asbestos and some of the cross fiber, of good quality, attains lengths of one inch.

The deposits are reported to occur on a ridge of dark rock, some 2½ miles long and half a mile wide. The location is easy of access, as a very good road is built within five miles of the deposits. It is the intention of the Bureau of Mines to examine this district at an early date.

The Asbestos deposits of the Province of Quebec, which at present supply between 85 and 90 per cent of the world's consump-

tion of this substance, are situated in a band or zone of igneous rocks, which, beginning in Vermont, enters Canada near lake Memphramagog, crosses the Eastern Townships in a north-easterly trend and extends, with gaps, as far east as Gaspé peninsula, where Mount Albert is one of the last outcrops known in Canada. This is known as the "Serpentine Belt," although serpentinized rocks only constitute a very small proportion of this system of intrusions. But from an economic standpoint the areas of serpentine are the important members of the series, as they contain the asbestos deposits.

The igneous rocks of the serpentine series consist of peridotites, dunites, pyroxenites, gabbros, diabases, granites, aplite, serpentines and talcose schists. The serpentine results from the alteration of the dunites and peridotites and it is in this altered rock that are found the asbestos veins. As to the general geological structure of the region it may be said to present a broad anticlinal fold, having a core of precambrian rocks, mainly quartzites, flanked on each side by Cambrian sediments, quartzose schists and grey-greenish quartzites of l'Islet formation, followed by ordovician shales and slates. As to the age of the intrusions, it is post-ordovician, for the igneous rocks cut all the sedimentary formations of this region.

There are now six producing centres of asbestos, the most northern one of which is East Broughton, situated sixty miles south of Quebec City; Robertson, ten miles further south, followed by Thetford Mines, Black Lake and Coleraine, all on the line of the Quebec Central Railway which joins Quebec to Sherbrooke. The sixth centre is at Danville, eighty miles south-west of Quebec, on the Grand Trunk Railway.

ASBESTOS IN OTHER COUNTRIES

**United States*—In the United States, chrysotile asbestos is produced in three States: Arizona, California and Wyoming. Hornblende asbestos is produced in Georgia, Maryland and Virginia. By far the greater portion of the total production of asbestos of the United States comes from two localities in Arizona, the principal one being at Ash Creek, some 28 miles, in an air line, and 42 miles by road, to the north-east of Globe; the second one is on Mount Baker, in the southern part of the Sierra Ancha, some thirty-five miles in an air line, to the north-west of Globe.

*See J. S. Diller Mineral Resources, United States 1917.

In the first of these localities operations are being carried on by the American Ores and Asbestos Company, while in the Ash Creek district the operators are H. W. Johns-Manville Co.; Penn Asbestos Mining and Refining Company; the Colorado-Arizona Asbestos Company; other properties were prospected.

In Wyoming a mine is operated by the American Fireproofing and Mining Company, twenty-eight miles south of Lander.

In California two companies are producing, the John D. Hoff Asbestos Company, of Oakland, and the Sierra Asbestos Company of Washington, California, operating in Nevada county and in Tuyo county.

The other states mentioned, Georgia, Maryland and Virginia, produce only amphibole asbestos, or "slip-fiber," which is brittle, weak, and the uses and applications of which are very limited.

The figures of production of asbestos in the United States for 1918 are not yet available, but in 1917, according to the United States Geological Survey, they were 1,683 short tons, valued at $506,056, or an average of $301 a ton. This high value comes from the fact that the greater part of the asbestos is long fiber; the mines of Ash Creek, Arizona, being situated forty-two miles from the railroad, only high-priced fiber can stand the cost of hauling.

Southern Rhodesia.—In all probability South Rhodesia is now the second largest asbestos producing country in the world, ranking after Canada. No statistics have been available from Russia since 1914, but all indicates that the importance of the Urals asbestos industry is only a fraction of what it was before the war.

The figures of production of asbestos in Southern Rhodesia for the year ending December 1918 were 8,574 tons, valued at $761,683. This is a decrease as compared with 1917, when 9,563 tons, valued at $925,714 were produced.

The main asbestos quarries of South Rhodesia are situated in the north-eastern corner of the Mashala mountains, on the road between Selukwe and Victoria. The asbestos is chrysotile, of a white colour and of comparatively good quality, although more brittle and less silky than the Quebec asbestos.

Union of South Africa—Cape Province.—The Cape asbestos is crocidolite, or "blue asbestos," an amphibole variety, of dark blueish lavender colour, strong fibre, but less resisting to heat than

the chrysotile-asbestos. The production of Cape asbestos increased from 2138 tons, valued at £35,899 in 1915, to 4,228 tons, valued at £74,293, in 1916, but the figures for 1917 fell back to 2,999 tons, valued at £49,485.

Owing to its different characteristics and qualities the Cape asbestos cannot be said to be a competitor of Quebec asbestos, and the fluctuations in the figures of production seem to indicate an irregular and spasmodic demand.

The Cape asbestos deposits occur in the Asbestos Mountains, in the northern part of the Province of Cape of Good Hope, and in Bechuanaland, in the districts of Preiska, Hay and Kuruman.

Transvaal.—In the Transvaal the asbestos industry appears to have made great progress in the last two years. The figures of production for 1918 are not yet available, but in 1917 some 3,193 tons, valued at £37,486, were shipped and sold, as compared with 407 tons, valued at £8,490, for the year 1916.

Occurrences of asbestos had been known for some time in the Carolina district in the eastern part of Transvaal, but they were never developed to any extent. The following note, in the annual report of the Government mining engineer for the Union of South Africa, for the year 1917, seems to indicate that some important new discoveries were made to the north of the known occurrences.

The extract is from the report of T. G. Trevor, in charge of the Pretoria inspectorate:—

"This district (Lydenburg district) has provided the most "sensational development of mining of the year. The asbestos "mines of Penge and the neighbouring farms have been developed "most successfully, and the deposits appear to be larger than any "others known in the world.

"An output of 500 tons a month was obtained and would have "been maintained indefinitely but for the heavy rains which have "rendered transport quite impracticable.

"This asbestos industry may go a long way towards replacing "the simple free-milling gold-mining of the past, which, as before "remarked, is gradually coming to an end."

In connection with the above development it may be mentioned that Dr. Percy A. Wagner in an article contributed to the South

African Journal of Industries, November 1917, describes the Lydenburg occurrence as follows:

"As regards occurrences of iron-amphibole asbestos, an asbestos "field of exceptional promise has been opened up during the past "two years in the northern portion of the Lydenburg district "of the Transvaal, the asbestos occurring in bedded veins in ferri- "ginous shales belonging to the basal portion of the Pretoria series, "at a slightly lower horizon than the Griqualand West deposits. The "deposits have not as yet been accurately delimited, but appear to "be of very great extent. The mineral was first discovered on the "Farm Penge, situated about 50 miles North of Lydenburg. At the "present time operations are confined to Penge and the adjoining "farm Streatham. These farms are situated in the valley of the "Olifant's river, where the latter breaks through the Drakensberg. "The area is mountainous and rugged and very inaccessible. The "distance by road to Lydenburg, the nearest point on the railway, "was originally 75 miles, but this has been reduced to 65 miles by "the construction of a more direct road. The asbestos is found in "long irregular lenses up to 12 inches in thickness that overlap in "such a manner as to form practically continuous layers extending "over hundreds of yards. The lenses conform to the stratification "of the enclosing rocks.

"The pale greenish fibre from the lower workings on Penge is at "present being shipped in considerable quantities to Japan and the "United States. It appears by reason of its length and great tensile "strength to be admirably adapted for the manufacture of asbestos "rope and textiles, and as no other field is capable of producing "fibre of this length in such large quantities, there can be no question "that the mineral is going to play a very important rôle in the "asbestos manufacturing industry. The precise mineralogical com- "position of the fibre has not as yet been determined. It is un- "doubtedly amphibole asbestos, apparently monoclinic with a very "small angle of extinction. It differs from tremolite and actinolite "in containing up to 37% of ferrous oxide; from crocidolite in being "apparently quite free from soda; and from all these minerals in "containing up to 9.3% of alumina. The various analyses so far "made are difficult to reconcile."

CHROMITE

In spite of the keen demand for chromite during the first half of the year and the consequent increase in prices, the tonnage produced in the Coleraine-Black Lake district is rather less than for 1917.

Returns of production of chromite were received from nine producers, the total quantity being 36,131 short tons, valued at $770,955. This, however, it may be explained comprises both the so-called "crude ore," that is ore in lumps, sufficiently rich to be shipped direct from the mine without concentrating, and low grade ore, below 30% of sesquioxide of chrome, which required treatment in the local mills. The quantity of chromite shipped from the district, of crude and concentrates, was actually in the vicinity of 21,500 tons. In 1917, the quantity produced had been 36,186 tons valued at $498,031, which previous to shipping had been reduced to "crude" and concentrates of a tonnage of about 23,000 tons.

As to value, the year 1918 constitutes a record which will not be reached again for a long time, unless some new unexpected sources come to light. As explained in last year's report, the world's usual sources of supply of chromite, Rhodesia and New Caledonia, were practically cut off as far as America was concerned, owing to the lack of ocean shipping space. The United States and Canada had to develop their own resources in that mineral to supply their needs, which an estimate had put at 160,000 tons for the year 1918. An appeal was made to all owners of chromite deposits to do all they could to produce as much as possible. In consequence the prices rose gradually until in May and June the quotations were $1.50 to $1.55 a unit for 45% ore with variations of 5c. a unit for grades above or below that standard. These prices were F. O. B. at shipping points. In the United States transactions were recorded at $100 a ton for 50% ore. By September the prices had eased off considerably to $1.40 and less, while in October the market could not absorb the supply. On the news of the signing of the armistice, the bottom practically dropped out of the chrome market, and at the end of the year only the operators having contracts to fill at prices which permitted to make ends meet were working. At present, in March 1919, only two operators are producing. It may be stated in a general way, that under the present conditions, chrome mining to be remunerative in the Province of Quebec requires a market price of 80c. to $1.00 a unit for 45% shipping ore or concentrates.

OPERATORS IN 1918

The *Quebec Asbestos & Chrome Company* worked very actively the chrome deposit which was opened during the latter part of 1916 by Mr. Douglas B. Sterrett, on lots 7 and 8, range X of Cleveland township, near Danville. The ore was produced mostly from open cuts, but during the year a shaft 196 feet deep was sunk. This is a two compartment shaft, 4 ft. 8 in. by 8 ft., well timbered, the timbering being reinforced with steel rods. From the shaft two cross-cuts have been driven, one, the first level, at 109 feet from the shaft collar, the other 75 feet lower.

The cross-cut at the first level was driven 191 feet, cutting one good vein 67 feet from the shaft. On this vein a drift has been opened, following the ore 100 ft. towards the south and 75 feet towards the north. Towards the south, the lens practically pinches out, but at the end of the year the north drift was still in ore.

On the second level a cross-cut has been driven for 74 feet. A little ore has been revealed.

In April 1918, the Quebec Asbestos & Chrome Company purchased from the Mutual Chemical Company the new mill which had been built on lot 7, range B, of Coleraine, to treat the ore of the old mines of the American Chrome Company, near little Lake St. Francis, mentioned in our report for 1917. This mill, both the machinery and the building, were moved to the property of the Quebec Asbestos and Chrome Company, at St. Cyr, and was put in operation in the early part of November. The machinery consists of a Blake crusher, a Hardinge mill, 6 feet by 22 inches, a standard Duplex Dorr classifier, a Dorr Thickener, a Duplex Callow screen, seven Wilfley tables and three Diester-Overstrom tables. The power is electric, a 60 H.P. motor for the Hardinge mill, a 30 H.P. for the Blake crusher and bucket elevators and a 15 H.P. for the other machines. The mill feed is eighty tons of ore a day. The property closed down in March 1919.

The *Mutual Chemical Company*, during the early part of the year, acquired, first by option then by purchase, the Lake Caribou Mine, on lot 19 N.W. range X of Coleraine township, from the Reed Estate, which is administered by the Royal Trust Company. Work was carried on continuously. A vertical shaft, located sixty feet from the workings, has been sunk to 122 feet, and the intention is to carry it down to 200 feet. A first level was driven towards the old open

pit, under which it passes. While the shaft was being sunk, mining was carried on in the open workings. In February the shaft was hoisting ore which is hauled to the company's mills, a short description of which was given in our last year's report. This is the mill of the Black Lake Asbestos and Chrome Company, which is leased by the Mutual Chemical Company of Canada, and which has been much improved by them.

This mill has also purchased ore from other sources, and has acted as a custom mill throughout the year. They have purchased ore as low as 8% chromite. In July the scale of prices paid for various grades was as follows:—8% ore, $2.10 a ton; 16% ore, $5.50; 20% ore, $7.15; 30% ore, $13.45.

Mr. J. V. Belanger, during the first part of the year, operated on lot 19 N.W. range X of Coleraine, until this property was acquired by the Mutual Chemical of Canada. The chromite deposit crosses the boundary line separating lot 19 N.W. from lot 19 S.E., and extends into the latter. Mr. Belanger's mill is located on No. 19 S.E., close to the boundary line, and he purchased the lot from the owners, the King-Chapleau Estate, and transferred his mining operations to this lot. A very good deposit of chromite has been brought to light and Mr. Belanger was one of the important shippers of chromite during the year. The new workings are in open cuts, but in November a shaft was started and in February this was down 30 feet. The mill has been enlarged and now consists, in the main, of fifteen stamps and four tables. While the recovery in concentrates is not very high, probably 65% on 15% ore, the results are satisfactory owing to the proximity of the mill, which is near the mine, and to the cheapness of operating the concentrator. Moreover, the upper part of the new deposit, which constitutes the extension of the Caribou Lake Mine deposit, is decomposed to the extent that the ore can be loosened by pick and shovelled into wagons, which haul it a couple of hundred feet to the mill.

This deposit on lots 19 N.W. and S.E. is irregular, but consists mainly of disseminated chromite, constituting milling ore, in a zone 100 feet wide by 1400 feet long. On either side of this zone small pockets of rich shipping ore occur.*

The deposits of the "Montreal Pit" on lots 25 and 26 range II., and those of the old Canadian Chrome Company, on lot 16, range

*Harvie. Eng. and Mining Journal, Vol. 107—No. 3.

"A" of Coleraine, were worked by contract for the *Dominion Mines and Quarries Ltd.* The ore obtained was practically all shipped as low-grade crude ore, without concentration.

The *Bennett-Martin Asbestos and Chrome Mines Ltd.*, carried on work on lots 25 and 28, range II. of Ireland township, and made substantial shipments of crude ore.

The *Black Lake Asbestos and Chrome Company*, the owners of blocks "A" and "B" of the township of Coleraine, two very large blocks containing some 6,000 acres, extracted chromite from various pits and deposits on their property, but all the work was done by contract. In the latter part of the year the company started a shaft at the Caribou Mine, on block "A," near Caribou Lake.

In addition to the above, reports were received, of work done during the year, on the following lots, and in some cases small shipments of chromite were effected:—

Coleraine township, lot 18, range "A"; lot 14, range "B."
Wolfestown township, lot 23, range III.
Garthby township, lots "B" and "C," range I., lots 5, 6, 7, 8, range II.
Broughton township, lot 26, range IX.

It may be mentioned that, at the request of the United States Government, the Canadian War Trade Board undertook to stimulate the production of chrome to meet an anticipated shortage due to restrictions then being placed on imports from overseas. Such restrictions had become necessary owing to shortage of ocean freight, all available boats having been put on the routes to France and England. Dr. Robert Harvie, the geologist in charge of the district for the Federal Department of Mines, was appointed in March 1918, as representative of the War Trade Board, and established his headquarters at Black Lake. The policy followed to attain an increased production was to improve existing facilities and to give direct assistance when possible, such as speedy granting of export and import licenses; the waiving of express regulations to facilitate delivery of machinery; obtaining military exemptions for skilled employees; improvement in freight-car service.

In an article to the Engineering and Mining Journal, Dr.

ensure a product which meets the requirements of the most exacting metallurgical practice." '

Mr. T. Crook* sums up the views as to the essential features of the manufacture of refractory magnesia as follows:

"(1) The finished products, whether as sinter obtained by dead-burning the raw magnesite, or as bricks produced by a second or further burning, or the pulverized compressed sinter, should consist essentially of crystalline magnesia. The Austrian practice aims at obtaining a sinter containing at least 83% of magnesia. Lime, silica and alumina are regarded as undesirable ingredients and should not exceed 5%, 6% and 2% respectively. Iron oxide is regarded as a desirable ingredient, but the amount of ferric oxide is not allowed to exceed 11% or so of the sinter."

"(2) The dead burning of the raw magnesite should be effective, since it is only the inert and comparatively dense, crystalline product (periclase), into which caustic magnesia becomes transformed by prolonged heating at temperatures upwards of 1,400° C. that can be regarded as refractory. The kiln temperature required varies with, and must be adapted to, the nature of the raw material. The temperature required for the sintering of Styrian magnesite is said to range from 1,400° to 1,600° C., the average being about 1,500° C., while that required for Grecian magnesite is stated to be much higher, but there appears to be scope for useful investigation in this subject."

"(3) The production of good magnesia bricks demands the use of pulverized sinter of good quality. The sizing of the grains, the nature and proportionate amount of the binder used where such is necessary, the pressure under which the bricks are moulded, the drying conditions, all these are controllable factors, and appear to be taken carefully into account in the Austro-Hungarian process of brick manufacture. The aim in this process seems to be to secure bricks, the volume shrinkage of which in the final burning operation does not exceed about 15%, and the nature of which renders them immune from any considerable shrinkage under the furnace conditions for which it is designed to use them."

"The manufacture of refractory magnesia thus clearly gives great scope for technical skill in management at every stage, from

*Magnesite, its occurrences and uses. Mining Magazine, London, February and March, 1919.

the careful dressing of the raw material and sintered product up to the production of finished bricks. It seems necessary to emphasize the importance of securing uniformity of quality in the raw material, since otherwise a manufactured product of standard quality can be hardly obtained. One may safely infer that, of the various factors which have contributed to the success of the refractory-magnesia industry of Austro-Hungary, one of the most important has been the careful standardization of the finished products, such as can only be obtained by dressing the raw magnesite and dead-burned magnesia so as to yield materials of steady quality."

Magnesite Brick.—In the summary report of the Mines Branch, Ottawa, Mr. J. Keele, chief of the Ceramics Division, reviews the subject of magnesite brick as follows*:—

"Several patents have been taken out with the object of making magnesite brick from raw magnesite in one operation of burning, by adding chrome iron ore as the sintering material in amounts up to 30%. Some test pieces of the above mixture were prepared by the writer, and burned at cone 25. The results of this test showed that the shrinkage in the burned bricklets was so great that the operation could not be regarded as being within the range of practical brickmaking. Moreover, the bricklets air-slaked and crumbled within two months after being burned. The crumbled material made up into bricklets and burned the second time also disintegrated some time after burning.

"Several other sintering materials, such as serpentine, iron ore, and kaolin, in amounts of 5 to 10 per cent. were tried, but without success. A mixture containing 90% of raw magnesite ground to pass a 10-mesh screen, 5% of iron ore and 5% of kaolin, gave the best results, as it did not air-slake and crumble after burning, but the shrinkage was abnormal.

"It appears certain that two burning operations are imperative in the manufacture of magnesite brick. The first burning may only be carried to the calcining temperature, so as to drive off most of the carbon dioxide. This operation also takes a large part of the shrinkage out of the material.

"If dead-burned magnesite is used for brickmaking it is usual to add 15% of light calcined magnesite with 85% dead-burned. This

*Summary report Mines Branch for year 1917, page 116.

mixture is thoroughly milled in wet pans, moulded by hand into brick shapes, which when partly dry, are repressed by machinery.

"In order to develop a bond and produce a strong hard brick, the burning must be carried to a very high temperature, usually from 1,500 to 1,700 degrees centigrade; or from cone 20 to cone 30, according to the composition of the material.

"If raw magnesite is used for brickmaking, the operation consists in mixing about 10% of iron ore with crushed raw magnesite, and milling the mixture in wet pans. The mixture is made into brick shapes by hand and burned in kilns at the calcining temperature, or about 1,000° C. The calcined bricks are broken down and milled a second time in wet pans and pressed into brick shapes by machinery. These are set in kilns when dry and burned to the necessary high temperature.

"Previous to the year 1915, the United States relied almost entirely upon the supply of Styrian magnesite, which was imported largely in the calcined state. Since then the hitherto unworked magnesite deposits in California and Washington have been drawn upon for use in the steel industry. Brickmakers in Britain imported both Styrian and Greek magnesite before the war, but since then magnesite bricks are made of magnesite from the Indian and Greek deposits.

"The following chemical analyses give the composition of the various bricks:—

	1	2	3	4
Silica	1.85	7.38	7.0	6.82
Alumina	2.47	1.36	7.0	1.28
Iron	5.95	7.72		1.88
Lime	3.45	7.85	1.0	3.78
Magnesia	85.40	73.80	85.0	83.50
Alkalis	0.31	....	....	0.34
Loss on ignition	0.66	1.89	....	2.48

1 American made brick in 1914. Analyst, R. T. Elworthy.
2 American made brick in 1917. Analyst, S. G. McAnally.
3 American made brick in 1918.
4 British made brick in 1917. Analyst, R. T. Elworthy.

Greek magnesite has usually more silica and lime, but much less ferric oxide than Styrian magnesite. Canadian magnesite* is ir-

*Magnesite Deposits of Grenville district, Argenteuil County, Que., M. E. Wilson, Memoir 98, Geological Survey.

regular in composition, but usually carries more lime and less iron than the European materials. The Washington magnesite is similar in composition to the Canadian occurrences.

"Some experiments in brickmaking were made in the laboratories of the Mines Branch on the grain magnesite produced at Hull. This material is very hard, so that when it is crushed and screened to the size of grain ordinarily used for brickmaking, it is found to be very gritty, and when wetted has no coherence, so that it would be impossible to press such a material alone, either by hand or by machinery. It is necessary, therefore, to add a bonding material which will enable the brick to be handled without damage as it comes from the presses.

"Lightly calcined magnesite which has a pasty consistency when wet is usually employed in amounts varying from 6% to 15%. When this mixture is thoroughly milled in wet pans it has sufficient coherence for moulding and can be made into brick shapes.

"If the dead-burned magnesite is ground very fine, so that there is considerable dust in the ground product, it is possible to mould it in a damp state without a bond in presses similar to those used for making dry-pressed building bricks.

"The best results were obtained by grinding the material so that it all passed a 16-mesh screen with 45 per cent passing through a 100-mesh. When ground to this texture the magnesite simply requires to be slightly moistened to prepare it for pressing. After being pressed and dried the bricklets harden so that they can be readily handled for setting in the kiln. The shrinkage after burning to cone 25 (1,630 degrees C.) was 2 per cent.

"If the magnesite is ground very fine, so that it all passes through a 100-mesh screen, fire checks are liable to develop in the burned brick, and the shrinkage will be higher.

"*Spalling of Magnesite Brick.*—One of the chief defects of magnesite brick is failure, from spalling and disintegrating, in use under repeated heating and cooling. The disintegration is very much hastened in the presence of the action of steam, even on thoroughly burned brick made with magnesite very low in lime or other impurities. In making some experiments on magnesite brick for the Royal Mint the writer found that all the trial pieces made up with the ground Canadian dead-burned magnesite bonded with light calcined magnesite, were subject to spalling when in the fur-

naces at the Mint. Brick made from Styrian magnesite behaved no better in this respect. When the Canadian dead-burned magnesite was bonded with 5 or 6 per cent of china-clay, however, neither spalling or disintegration occurred during prolonged trial in place in the furnace.

"The brick made with 12 per cent china-clay as bonding material, and burned to cone 25, were very dense and strong, with a flinty fracture, but they have a tendency to deform if burned to a higher temperature than this. When the magnesite is ground to pass a 12-mesh screen, bonded with 6 per cent of china-clay, and burned at cone 25, a much stronger brick is obtained than when calcined magnesite is used. Furthermore, it has the advantage of not being so liable to spalling and disintegration. The objection, however, to the use of clay as the bonding material is that it increases the silica content of the brick, so that it may not be able to withstand the corrosive action of basic slags, or the great heat in the roofs of electric furnaces.

"The following chemical analysis shows the approximate composition of the grain magnesite from Hull when bonded with 6% of kaolin.

Silica	18.52
Alumina	4.18
Iron	6.00
Lime	14.5
Magnesia	64.18**"

In a paper read before the Ceramic Society of Great Britain, Mr. T. Crook*, of the Imperial Institute, read a paper on Magnesite which we quoted before, and of which we here give copious extracts. Mr. Crook makes a distinction between the ferrous carbonate of magnesia and magnesite proper. The first, or breunnerite, includes spathic material containing from 5 to 30% of isomorphously mixed ferrous carbonate. Spathic magnesium carbonate containing less than 5% of ferrous carbonate he classes as spathic magnesite.

Magnesite deposits of Styria.—"The only deposits of the breunnerite type that have hitherto proved to be of economic importance are those of the metamorphosed Carboniferous strata of Styria,

**J. Keele.—Department of Mines, Ottawa; Summary Report Mines Branch, 1917.

*See "The Mining Magazine," London, February and March 1919.

Lower Austria, and Northern Hungary. Breunnerite is abundant in this region, which is famous also for its spathic iron ores . . . . The Styrian and Lower Austrian deposits have the advantage that they are much nearer their Adriatic port than are those of Northern Hungary, and it is from them that most of the Austro-Hungarian magnesite hitherto exported has been obtained. They are situated in the region to the southwest of Vienna, along a tract extending westward from Semmering through the Murz valley to the Tyrol. The chief deposits, taking them in order from east to west, are those of Semmering, Veitsch, Breitenau, Treiben, Radenthein, and Dienten. Of these the largest and most important appears to be that of Veitsch, which is situated near Mitterdorf, a station on the South Austrian railway in the Murz valley, in Styria. The geological structure of this district, like that of so many parts of the Alpine region, is very complicated. The magnesite occurs as lenticular masses in a belt of foliated Carboniferous rocks belonging to the so-called greywacke zone. They are chiefly metamorphosed shales, sandstones, and conglomerates, but include a limestone the fossils of which show it to be of Visean (Lower Carboniferous) age. The chief lenticular mass of magnesite near Veitsch forms the main part of the Sattlerkogels, a hill lying a kilometre or so to the Northwest of the village. The summit of the Sattlerkogels is about 3,260 ft. above sea-level, and nearly a 1,000 ft. above the level of the Veitsch works. The magnesite is quarried on the slope of the hill in a series of terraces about 50 ft. apart through a vertical distance of nearly 500 ft. The magnesite lens is three-quarters of a mile in length, and over a 1,000 ft. in width. So far as can be judged from its disposition it probably extends to a considerable depth . . . . The magnesite of Veitsch and many other localities in this region is of the breunnerite variety. It is greyish in colour when fresh, and contains sufficient isomorphously intergrown ferrous carbonate to blacken when calcined in a reducing atmosphere. In this respect it behaves like the white patches of ankerite seen in most specimens of English coal. It also behaves like ankerite in turning brown when exposed to the air. The amount of iron carbonate is variable, and various analyses show percentages ranging up to 13 or 14%. A little pyrite is present in the form of scattered granules, more especially in the pinolite variety."

"Although selected specimens of the Sattlerkogels breunnerite show so much variation in the percentage of ferrous carbonate present, there is comparatively little variability in the percentage

of iron oxide in the sintered product as marketed. This may be seen from five analyses of sintered magnesite quoted by Cornu, which show variation between the following limits. Magnesia (MgO) 85.53 to 90.07, Lime (CaO) 0.96 to 3.52, Ferric oxide (Fe_2O_3) 7.43 to 9.96 Manganese oxide (Mn_3O_4) 0.51 to 0.76, Silica (SiO_2) 0.26 to 1.34, Alumina (Al_2O_3) nil to 2.22."

"A. Kern (in Gluckauf, 1912) quotes the following analyses of sintered magnesite from some of the more important Austrian localities:

	Veitsch	Brei-tenau	Sem-mering	Sunk	Salz-burg
	%	%	%	%	%
Magnesia (MgO)	84.2	87.9	85.9	85.9	86.7
Lime (CaO)	2.5	2.8	3.0	4.5	2.0
Ferric oxide (Fe_2O_3)	8.4	5.5	5.3	6.8	5.9
Alumina (Al_2O_3)	.....	0.7	0.1	1.4	1.1
Silica (SiO_2)	3.8	2.0	5.1	0.6	2.2

"The smaller variation in composition shown by the sintered material as compared with selected specimens of the raw magnesite is doubtless due to the moderation effect of the crushing, dressing, and sintering operations, which are accompanied by a fairly thorough mixing of the ground material."

"According to Cornu, dolomite is abundant in the Veitsch magnesite deposits. It occurs partly as a fine-grained, greyish black rock, containing in places dolomitized crinoid ossicles . . . . In addition to the fine-grained dolomite, the Veitsch magnesite deposit contains a large amount of coarsely crystalline and yellowish-white masses of dolomite. Large cleavage fragments of 10 to 20 cm. edge are obtainable from these masses of coarse-textured dolomite which are enclosed in the Veitsch breunnerite. Such included lumps of dolomite are naturally regarded as objectionable by the quarrymen, and have to be eliminated as far as possible either by cobbing in the quarry, or in subsequent dressing operations, as otherwise the product obtained would contain too much lime. The colour of the dolomite lumps helps the quarrymen to detect their presence . . . . In view of the intimacy of the association of dolomite and breunnerite at Veitsch, one might expect that the dolomite would be largely ankeritic. This does not seem to be the

case. Analyses of the dolomite show that it is fairly steady in composition and contains only 1 to 2% of iron carbonate. It is fortunate that this is so, for if the dolomite were largely ankeritic, it would be difficult, if not impracticable, to keep down the lime percentage in the sintered product. The elimination of fairly pure dolomite from breunnerite in dressing operations is an easy matter, whereas the elimination of normal ankerite would be practically impossible."

"Lime is regarded as an objectionable ingredient in calcined magnesia, and efforts are made to keep its percentage as low as possible in the sintered product. Austrian sinter usually contains a variable but small percentage of lime, which may be safely attributed to the presence of dolomite, perhaps slightly ankeritic, in the raw material."

"According to J. Horhager (Stahl und Eisen, June 15, 1911, p. 955) and A. Kern (already quoted) the quantity of waste rock obtained in quarrying may amount to about *two-thirds of the total bulk of the rock*. The cleaner portions of the rock are reduced to pieces about head-size. Less pure material has to be broken into smaller pieces, of fist-size, and its dressing involves a considerable loss of magnesite in the form of fragments smaller than nut-size, which are too small to be burned in shaft kilns. The raw magnesite thus obtained in the quarries at Sattlerkogels is readily transported by aerial ropeways and shoots to the sintering kilns at the foot of the hill."

"The sintering temperature varies from 1,400°C, for breunnerite containing a considerable percentage of iron oxide to 1,700°C. for magnesite poor in iron oxide, but, however easily the material sinters it is, according to Hörhager, desirable to carry the temperature up to at least 1,500°C., and, this temperature seems to be exceeded as a rule in Styrian shaft kilns."

"According to L. C. Morganroth (Bull. Amer. Ins. Min. Eng., 1914), kilns of the rotary type have been installed at several places in Austria, powdered coal being used as fuel, but they suffer from the disadvantage of yielding a larger percentage of fines . . . . According to Hörhager the amount of fuel required to sinter Austrian magnesite is variable, and depends on the amount of ferrous carbonate present; but with good flaming brown coal having a calorific value of 6,000 calories, the amount of coal required is from 0.3 to 0.4 tons per ton of sintered magnesia produced. Kern puts the fuel

requirement at 0.5 ton brown of coal (calorific value 4,000 calories) per ton of sintered magnesia produced."

"The crushed sinter, as a rule, requires to be further dressed to eliminate impurities, for these are far from having been completely removed before sintering. For this purpose the grains are classified mechanically. Much of the caustic lime or calcined dolomite falls to dust and is easily eliminated in the finest screenings. The coarser grains are readily dressed by hand-picking, the light-coloured and therefore readily-distinguished impurities, such as talc, calcined dolomite, and tridymitized quartz being easily removed. The less coarse material is presumably in large part marketed in a comparatively impure condition, or otherwise requires to be treated magnetically to remove particles of schist, silica, calcined dolomite, and other impurities that are magnetically non-permeable. This magnetic treatment, which involves much waste, adds considerably to the cost of the material, and is presumably only carried out when it is necessary to concentrate the sintered magnesia and thus secure a more refractory product."

"In addition to the sintering and dressing plant near Veitsch, there are works at other localities in Styria, including those at Breitenau and Trieben. There are also works at Eichberg near Gloggnitz, in Lower Austria."

"At Veitsch, transport of the refined sinter from the kilns to the goods depot at Wartberg station is effected by an aerial ropeway over four miles long. The works at Breitenau are situated at the foot of the Hochlantsch (5,700 ft.), where terrace-quarrying and other working conditions closely resemble those at Veitsch and Eichberg. The Trieben works are near the station at Trieben, and are some three miles from the deposits at Sunk where the magnesite is quarried. The deposit at Radenthein has been worked since 1908 by American capital, and from that date down to 1915, large quantities of sinter were shipped to Philadelphia, New Orleans, and New York."

"The oversea exports of sintered magnesia from all these works in Styria and other parts of Austria were shipped at the port of Trieste."

"The Austrian magnesite formation stretches eastward beyond Vienna into Northern Hungary, where large magnesite deposits are quarried between Jolsva and Nyustya in the Gömör district. These

northern Hungarian deposits have much in common with the Austrian, and in spite of their great distance inland from the Adriatic there were considerable oversea exports in pre-war days from Fiume, to which port they were railed some 360 miles for shipment to various parts of Europe and America."

"A factor of much economic importance in the magnesite industry of Austria-Hungary is the abundance and accessibility of brown coal which is used in the sintering kilns. If to this we add the further considerations that the deposits are large and easily quarried, that they are within easy reach of transport facilities, and that labour is cheap, we see that Austrian magnesite mining has all the prime essentials of a successful and enduring mineral industry. It is necessary to give due prominence to these considerations if we wish to understand the success that Austrian magnesite mining has achieved in the past, and the competitive pressure it is likely to exert in the future."

GRAPHITE

The graphite industry in the Province of Quebec gave very unsatisfactory results in 1918, and this was a low ebb year. The total production amounted to 326,308 lb. of all qualities, valued at $33,274, as compared with 1,078,000 lb. valued at $99,024 in 1917. The results obtained in 1918 are very disappointing, for during the two previous years the comparatively high production had led to believe that the main difficulties which have beset the graphite industry since its inception had been solved, and it was anticipated that a steady production could be counted upon in the future.

The New Quebec Graphite Company worked until the end of April 1918, when both mine and mill closed down owing to the difficulty of getting efficient labour and to the very high cost of supplies. However series of experiments were carried on during the summer, with a view to improving the recovery which has always been unsatisfactorily low. These experiments are said to have been successful, and work will probably resume in the spring of 1919 if market conditions warrant it.

The Plumbago Syndicate, who took over the property of the Dominion Graphite Company in 1914, lots 20 and 21, range V of Buckingham, did not resume mining in 1918. In July this company began some experimentation work on the concentration of graphite

Canadian Johns-Manville Co. Ltd., Asbestos, Que.—Loading mine cars with steam shovel.

The New Quebec Graphite Co., Buckingham, Que.—Concentrating mill.

by oil flotation, and in August they installed Callow cells, two roughers and two cleaners. Unfortunately early in October the mill was completely destroyed by fire, and in March 1919, no steps had yet been taken to resume activities.

The Consolidated Graphite Mining & Milling Company, with head office in Nashville, Tennessee, took over the old property of the Peerless Graphite Company, who owned mining rights on lots 12, 13 and 14, range X, and lot 12, range IX of Buckingham township. The mill is built on lot 14, range X. They were in operation in the early part of the year using a dry process of concentration, which, however was not satisfactory. In the fall of 1918, steps were taken to replace this dry process by an oil flotation system and alterations proceeded during the winter, preparatory to resuming mining operations in the spring of 1919.

During the fall some diamond drilling was done on the property of the Canadian Graphite Company, on lot 1, range III of the township of Wentworth, north of Lachute. These operations were being carried on by Chicago interests who had the property under option of sale.

Prospecting operations were carried on by Graphite Products, Limited, in the township of Amherst; also by Mr. Jos. Fumerton and by Messrs. McLean and Fitzsimons in the township of Low.

Graphite deposits, on which considerable work has been done, occur in the townships of Grenville, Buckingham, Lochaber and Amherst, all to the north of the Ottawa river, between the cities of Montreal and Ottawa. The graphite is found in flakes, disseminated in crystalline limestones and sillimanite gneisses of the Grenville series, probably remnants of highly metamorphosed sediments of Pre-Cambrian age. The ore treated contains from 8 to 12% graphite, but is very refractory to concentration treatment. Both dry and wet processes have been tried and gradually elaborated, but none, so far, seems to have been efficient. Some claim a recovery of 60 or 65% of the content in graphite, but in such cases the grades of the products may not be up to the required standards. Considering the industry as a whole, a recovery of more than 50% of the content of the ore appears to be exceptional rather than the rule. Great hopes are built at present on the applicability of the flotation principles to the separation and concentration of graphite. Alabama has been a pioneer in this line, and Dr. W. F. Prouty, of

the Geological Survey of Alabama reviews this subject as follows.*

"Since 1915, oil flotation processes have been tried in a number "of Alabama mills, and on the whole are proving more popular than "any other method of concentration. Both Callow and Mineral "Separation cells are being used. The treatment of the ore in these "plants varies chiefly in the kind of classifier used in front of the "cells, or in the method of the reduction of the ore,—as gradual "reduction by rolls or reduction by ball mill.

"Three other distinct but somewhat similar oil-flotation pro- "cesses are to be noted in the field at this time. In each of these "the agitation, if such it may be called, is accomplished by jets of "water taking the air down into the oil-water-ore mixture. In each "of these instances, unlike the results obtained in the Callow and "the Mineral Separation processes, there is no accumulation of "froth. In the Cobb jet-washer, the jets of water are introduced "along the central axis of a rectangular wooden trough. The "launders are placed on the sides of the trough and there is a "bottom discharge for the tailings. The Simplex washer is of metal "and is elliptical in shape. The jets of water near the center cause "a circular and outward movement of the surface water and the "graphite toward the peripheral launder. In the Loventhall-Nun- "naly washer there is a combined water jet and an inclined screw "conveyor. The graphite floats off in much the same manner as "when the log washer is used; the sand is also disposed of in a similar "way."

"In most of the mills, the dried concentrate is first sized and air "treated, to eliminate as much sand as possible. In some cases a "small percentage of the flake thus air-treated is sufficiently high "in carbon to go immediately in the shipping room, but the larger "percentage of the concentrate must be run through the buhr to "polish the flake and separate it from the attached mineral particles, "which tend to keep down the carbon content of the finished pro- "duct." Dr. Prouty further says, that "After careful consideration "of the cost of production, and allowing for a reasonable profit only, "the Graphite Producers' Association of Alabama has suggested "the following prices as being just, at this time, both to the producer "and to the manufacturer. To this suggestion the Government has "consented, although there has been no price fixing."

*Engineering and Mining Journal, January 25th, 1919.

SCHEDULE OF PRICES ADOPTED BY THE GRAPHITE PRODUCERS' ASSOCIATION OF ALABAMA

Grade	Per cent Carbon	Price per lb.
No. 1 Flake	90	20½
No. 1 Flake	85	15½c. (a)
No. 2 Flake	80	10c. (b)

(a) With 1 cent added for each per cent. above the 85% carbon.
(b) With ½ cent added for each per cent. above the 80% carbon.

Per Cent Carbon	Price per lb.	Per Cent Carbon	Price per lb.
25 to 30	1c.	60 to 65	4½c.
30 to 35	1¼c.	65 to 70	5½c.
35 to 40	1½c.	70 to 75	6½c.
40 to 45	2c.	75 to 80	7½c.
45 to 50	3c.	80 to 85	10c.
50 to 55	3½c.	85 to 90	12c.
55 to 60	4c.		

"*Terms.*—F. O. B. Ashland, Alabama, or nearest shipping point; 75% of invoice payable upon receipt of bill of lading; balance upon receipt of satisfactory examination of material."

An oil flotation process, Callow cells, has been introduced in the milling practice of the American Graphite Company, a subsidiary of the Joseph Dixon Crucible Co., operating a mine in the Adirondack region, at Graphite, Warren county in the state of New York. This plant was put in during the summer of 1918, and in November, in answer to an enquiry from the constructing firm who had made the alterations and put in the new process in the mill, the American Graphite Company wrote: "In response to your enquiry as to how the flotation system installed by your company is doing, I am happy to advise you that its performance is most satisfactory and that we are highly pleased; that it is causing us no trouble whatsoever; the recovery of graphite is excellent; grade of concentrates high; and labour costs very low.*

MICA

The production of mica in the Province of Quebec in 1918 was 905,521 lb. valued at $202,149. This is a decrease of 626,099 lb. or 40% in quantity and $79,085. or 28% in value as compared with 1917.

*Engineering and Mining Journal, February 8th 1919, page 281.

The great differences in price of mica, as marketed by the producers, render general statistics of mica very unsatisfactory. Moreover the nature of the products varies from scrap mica quoted ½ cent a lb. which is used to make pulverized mica, to clear large sheets of thumb-trimmed mica 4 x 6 which sell for $2.50 a lb. Apart from these standard sizes small quantities of large sheets which may be needed for special purposes bring much higher prices up to $4, or $5. a lb. However, the quantity used of sheets larger than 4 x 6 inches is small and producers sometimes have to keep such large plates in stock a long time before finding a market for them at adequate prices.

Operators of mica mines put this mineral on the market in different forms, the principal ones being rough-culled mica, thumb-trimmed mica, thin-split mica, and scrap mica. The latter is further prepared mainly in the manufacture of pulverized mica of different sizes up to 200 mesh, but none of the mica miners operate pulverizing mills in the province of Quebec, whereas several have trimming and splitting shops, where they prepare the product of their mines, and in the reports received by the Bureau of Mines it is frequently difficult to differentiate the various forms and qualities. Hence the necessity of aggregating them into one whole.

An attempt to classify the total production of 905,521 lb. gave the following results: rough-culled mica 301,000 lb., valued at $25,000. or an average of 8.3 cents per lb.; thumb-trimmed mica 409,000 lb., valued at $108,000 or an average of 26.3 cents per lb., the balance being made up of scrap mica at 1½ cent a lb. and of the thin split mica at 49.2 cents a lb.

The mica production of the Province of Quebec entered for about four-fifths in the total mica production of Canada in 1918. By far the greater proportion is exported. According to the "Trade of Canada Report," issued by the Department of Trade and Commerce, the exports of mica for the calendar year 1918 amounted to 865,894 lb., valued at $409,990. The exports during the last nine months of the year were distributed as follows: to United States, 494,016 lb., valued at $227,982; to United Kingdom 56,151 lb., valued at $38,730; other countries 18,366 lb., valued at $1,933.

The considerable higher value per pound of the mica "exported", as compared with that of the mica "produced", is due to the fact that most of it undergoes a certain preparation before being

shipped out of the country such as, trimming, grading, splitting, by which the value is enhanced.

Mica prices during the year were at least equal to the prices which obtained in 1917, but on the other hand, the costs of production were much higher and this considerably narrowed the margin of profits. Both labour and supplies advanced to such an extent that many operators closed down, or worked at a loss. Towards the close of 1918 the prevailing prices, per lb. at Ottawa, were as follows:—

1 x 1 inches	10c.	2 x 4 inches	75c to 90c
1 x 2	17c.	3 x 5	1.50 to 2.00
1 x 3	30c.	4 x 6	1.75 to 2.50
2 x 3	40-55c.		

The main sources of the world's supply of sheet mica are India, Canada and United States, in order of their importance. India alone produces about two-thirds of it, and by far the greater part of Indian sheet-mica is exported to England and sold there, quite a large proportion of it being purchased for the United States.

*"Mincing Lane, London, is the market for nearly all the mica produced in India. Every three weeks there is sale in London by the produce brokers. Two days before the sale, the brokers have samples of various grades of mica from each shipment on show at a warehouse. These samples are carefully inspected by mica buyers, and the shipments are sold at auction on the third day. At these sales, Indian mica predominates; smaller lots from South Africa, Australia, Ceylon, Japan, Mexico, Bengal, and Canada are sporadically offered. Most of the mica imported into New York is purchased in London, but mica is sold on contract by large purchasers in India to Germany and the United States direct. On account of the personal factor in grading mica, there can easily be an honest difference of opinion whether a lot is up to standard or not; and to sell by any other method than open auction is a matter of some difficulty. At nearly every sale some utterly worthless mica appears, shipped from some out-of-the-way corner of the world by some ignorant but hopeful individual, who has heard of the value of mica, but does not understand the qualities required to make it marketable. Most of the Indian shipments are made by 10 or 12 firms who mine for themselves and purchase from the small producers. The

*A. F. Dixon. Indian Mica Industry. American Inst. M. E. Bulletin, May 1913.

artificial fluctuation brought about by the speculators and the fluctuating demand for each variety make it difficult for even the best informed to give more than a rough estimate of what a given lot of mica should bring. Giving statistics of the value of mica by the ton without regard to size or quality, as is the custom, may be interesting, as showing the state of the industry, but can give no one an idea of what a particular lot will fetch."

Indian sheet mica is graded according to size as follows:

Specials.	Over 36 square inches
Grade No. 1—from 24 to 36	sq. "
Grade No. 2—from 15 to 24	" "
Grade No. 3—from 10 to 15	" "
Grade No. 4—from 6 to 10	" "
Grade No. 5—from 3 to 6	" "
Grade No. 6—from 2 to 3	" "

As it has been mentioned above, the exports of mica to England during nine months of 1918 amounted to 56,151 lb., valued at $38,730. This is quite insignificant as compared with the quantity and value of Indian sheet-mica marketed in London. This preponderance is not due to the quality of the mica itself, for Canadian mica is superior to mica produced in both India and the United States. Our mica is of the variety phlogopite, or "amber-mica" of commerce, which is more pliable, more elastic and possesses better insulating qualities than the variety muscovite, which constitutes the total production of the two latter countries.

The preference of the English buyer to purchase Indian mica rather than Canadian mica, comes from the fact that the grading and sorting of the former can always be relied upon as being exactly according to samples submitted or exhibited, whereas many disappointments have followed the purchase of Canadian mica. In many cases even the first shipment has shown such wide variations from the samples on which it was purchased that a "repeat" order was out of the question. On the other hand some Canadian mica dealers complain of the unreasonableness of English mica buyers, but on the whole, there is no doubt that great improvement in the relations of our mica producers with the English market would result from a more rigid standardization and grading of our sheet-mica prepared for foreign markets, and a strict conformance of the quality of the shipments with the grade of samples submitted.

MINERAL PAINTS

Iron Oxide and Ochre

Natural iron oxide and ochre, calcined and raw, were produced in 1918 to the amount of 17,317 tons valued at $112,440, a substantial increase of 87% in quantity and 62% in value, as compared with the previous year 1917. The larger proportion in the increase of quantity is due to the fact that a great deal more raw iron-oxide, for use in the purification of gas, was shipped. The raw ochre shipped was valued at an average of $3.11 a ton and the prepared calcined ochre $26.78. The treatment for the preparation of the latter includes grinding, screening and levigating, after calcination.

The operators were the same as last year.

The Canada Paint Company, at Red Mill, near Three-Rivers, produced calcined iron oxides, of various shades and colours. These are exclusively for the manufacture of paints.

The Champlain Oxide Company, who operate a deposit at Champlain, Champlain county, also produce calcined natural oxides, for paints.

Thos. H. Argall, operates a natural oxide deposit at Pointe du Lac, county St. Maurice, for raw material, which is used in the gas works for purifying the gas, by removal of the hydrogen sulphide it contains.

Mr. P. Jobidon shipped some natural ochre from his deposits at Petite Romaine, township of Iberville, on the North shore of the lower St. Lawrence river. This material is used as a filler in paper manufacture.

The Paint Products Company of Canada, did a great deal of work on their deposit, near l'Ascension. Their property comprises lot 18, range IV and lots 19 and 20, range III of the township of Lynch, in Labelle county. The main works are on lot 18, on the east side of the valley of the Rouge river.

This deposit is quite extensive and the material is of very good quality, the calcined product containing over 90% of iron peroxide.

In the latter part of the year the company started to build large works consisting in drying sheds, calcining ovens, grinding

mill, and storage sheds to put in the supply of raw material for the winter.

It is expected that the works of the Paint Products Company will be in full operation in the summer of 1919.

SILICA AND QUARTZ

The silica and quartz produced in the Province of Quebec, have largely been used in the manufacture of ferro-silicon; of abrasives made in the electric furnace; in glass making; as flux in the manufacture of phosphorus. For these purposes, sandstone, vein quartz, and pure sand washed out of kaolin, were used. The total quantity of these substances produced in 1918 was 23,286 tons, valued at $61,669.

The Cascade Silica Products Company, 103 St. François Xavier St., Montreal, operates a sandstone quarry at Cascades Point, at the lower end of the Soulanges canal, in a deposit of Potsdam sandstone. They also have another quarry at St. Canut, near St. Jérôme, also in Potsdam sandstone.

The Montreal Sand & Gravel Company operate a Potsdam sandstone quarry at Mélocheville, at the foot of Beauharnois canal. This sandstone is used, to a great extent, in the manufacture of glass, particularly for bottles.

The Silica Products, Registered, 45 St. Alexander Street, Montreal, of which Mr. K. Stinson is now sole owner, opened and worked a quarry at St. Canut, on an outcrop of Potsdam sandstone, high in silica, which was in a great measure used for the manufacture of ferro-silicon.

There was a very keen demand for silica during the early part of the year 1918 for the manufacture of war material, principally for ferro-silicon which was largely used for the production of hydrogen for filling observation balloons, dirigibles, etc. "Siemens and Schuckert* were the original investigators and worked out a process for the production of hydrogen from the reaction:

$$Si + 2\,Na\,O\,H + 2\,H_2O = Na_2\,Si\,O_3 + 2\,H_2.$$

The process was a chemical success, but due to the high price of silicon, was not economical."

*See Chemical and Metallurgical Engineering, March 15th, 1919, page 289.

"In order to reduce the cost of the pure silicon, Captain H. Lelarge substituted silicon alloys in the process, using in preference ferro-silicons containing 50 to 80% silicon. The plants built for war purposes may be utilized in peace time in oil refining by the water-glass method and hardening by hydrogenation, offering an outlet for both the sodium silicate and the hydrogen at abnormally low costs."

Therefore for the manufacture of ferro-silicon for the generation of hydrogen, the iron content of the silica need not be very low, but on the other hand very close tests are made for the presence of phosphorus and sulphur, which are said to be very undesirable elements.

Two plants for the manufacture of ferro-silicon were constructed in the Province of Quebec in 1918, viz: The Canadian Ferro-Alloys Company, at Shawinigan Falls, and the Leaside Munitions Company, at Beaupré, near Quebec.

Owing to the demand for information regarding possible sources of silica in the Province of Quebec, Mr. A. O. Dufresne, of the staff of the Quebec Bureau of Mines, spent a few days examining the outcrops of Potsdam sandstone in the vicinity of Montreal and near St. Jérôme. The following remarks are compiled from his notes:

In the region of Montreal, and south west part of the Province of Quebec, the main source of silica at present available, is found in numerous outcrops of Potsdam sandstone, the nature and composition of which show considerable variations, but it is occasionally found remarkably pure. Its colour varies from pale grey to pale yellow. Much of it can be used for the manufacture of common glass.

The quarry of the *Cascades Silica Products Co.*, is situated at Cascades Point, at the lower end of the Soulanges Canal. The face of the quarry measures 500 feet long by 12 feet high. The stone is much fissured and could not be used as building stone. The colour is grey-white, but the fissure planes have a rusty colouring. The stone from the quarry is hauled up by an inclined trestle to a jaw crusher, then to crushing rolls, which reduces it to sand. The sand is put through trommels, 8 and 12 mesh to the inch, from which it goes to washing troughs, and is carried, by a conveyer belt 236 feet long, to storage bins, from which it is loaded into cars.

Analyses of Cascade Point sand, after washing:

	1	2
Silica	98.62	95.36
Ferric Oxide	0.38	0.40
Alumina	0.42	1.08
Lime	0.47	1.97
Magnesia	none	0.96
Sulphuric anhydride	trace	0.09
Phosphoric anhydride	.....	0.013

1 Canadian Inspection and Testing Laboratories.
2 Provincial Government Assay Laboratory.

This sand is widely used in steel and iron foundries. Some of it enters the manufacture of scouring soap.

The *Montreal Sand and Gravel Company* work a quarry in the first range of Melocheville, at the foot of the Beauharnois canal. This sandstone is also crushed but not washed. The crushing plant comprises a jaw crusher, rolls, screens, to treat 45 tons a day. As all the operations are dry, the crushing plant is very dusty.

An analysis of the sand gave:

	3
Silica	90.14
Iron peroxide	1.12
Alumina	0.50
Lime	1.67
Magnesia	6.04
Sulphur anhydride	0.418
Phosphorus anhydride	0.108
Arsenic	none
Difference	0.004
	100,000

3 Provincial Government Assay Laboratory.

Practically the whole of Ile Perrot, an island which is situated between Lake St. Louis and Lake of Two Mountains at the western end of Montreal island, is underlain by Potsdam sandstone. A quarry was opened by Messrs. Quinlan and Robertson on the north side of the island, opposite Macdonald Agriculture College. The opening of this quarry is 300 feet by 300, and the face is 16 feet high. An average sample of the quarry was analysed at the Provincial Assay Laboratory and results are given below in analysis No. 4.

Montreal Sand and Gravel Company Ltd.—Crushing Plant at Melocheville, Que.

Canadian China Clay Company Ltd., St. Remi d'Amherst—Steam shovel operations.

A very favourable exposure of Potsdam is found on Ile Perrot opposite Baie d'Urfé. The stone is white, and the grains appear to be of very uniform size. An average sample taken in various spots of the exposure, on the surface, was analysed at the Provincial Laboratory and the results given as analysis No. 5.

	No. 4	*No. 5*
Silica	94.48	97.24
Iron peroxide	0.80	0.24
Alumina	1.32	0.52
Lime	2.04	0.96
Magnesia	1.09	0.83
Sulphur anhydride	0.18	0.007
Phosphorus anhydride	0.018	trace
Arsenic	none	none
..... and loss	0.077	0.203
	100,000	100,000

No. (4) Sample from Quinlan and Robertson Quarry, Ile Perrot.
No. (5) Sample from exposure of Potsdam sandstone, Ile Perrot, opposite Baie d'Urfe.

This band of Potsdam sandstone which occupies part of the counties of Soulanges, Beauharnois and Vaudreuil, extends towards the north into the county of Two Mountains, and very good exposures of a very pure sandstone are found in the vicinity of St. Canut, to the east of St. Jérôme. On cadastral lot 130, of St. Canut, a quarry was opened to the south of the Canadian Northern Railway track, by the Stinson-Reeb Supply Company, but later all the rights were acquired by Mr. Kennedy Stinson. Work in opening the quarry was begun in January 1918 and in July of that year the face was 75 feet long by 15 feet high, and a crushing plant for 150 tons a day, was being erected. The quarry is connected with the C.N.Ry. by a spur or siding, three quarters of a mile long.

An average sample of the stone, picked in various spots of the face, was analyzed by the Provincial Laboratory. (See below analysis No. 6.)

Exposures of Potsdam sandstone occur also on the next lot No. 129, which was aquired by Mr. Aurelien Boyer, of Montreal, who intends to open a silica-rock quarry on it. Two samples were collected from this outcrop and analyzed at the Provincial Government Laboratory (Nos. 7 and 8).

	No. 6 (Lot 130 St. Canut)	No. 7 (Lot 129 St. Canut)	No. 8 (Lot 129 St. Canut)
Silica	99.42	99.72	99.78
Iron peroxide	0.12	0.12	0.18
Alumina	0.16	trace	trace
Lime	0.07	.....	.....
Magnesia	0.09	.....	.....
Sulphur anhydride	0.10	.....	.....
Phosphorus anhydride	trace	.....	.....
Arsenic	none	.....	.....

As mentioned in the report of Mining Operations for 1917 the Cambrian sandstones or rather quartzites, of the Kamouraska formation, which are well developed along the south shore of the St. Lawrence in the counties of l'Islet and Kamouraska, offer an unlimited supply of silica of high grade. They were first examined in 1908 by J. A. Dresser, who pointed out their possibilities for the glass industry. Mr. L. Heber Cole, mining engineer of the Department of Mines, Ottawa, has recently made an investigation of the various possible sources of silica in Eastern Canada, and he has thoroughly looked into the occurrences of quartzites of Kamouraska county*. The exposures which are most favourably situated from the standpoint of cheap transportation appear to be a group of islands called "Les Pélerins," which are entirely composed of the white "Kamouraska" quartzite. On the admiralty charts these islands are designated as the Pilgrim islands. There are five of them, called respectively Little Pélerin Island, area 97 acres; Long Pélerin island, 344 acres; Middle Pélerins island, two islands of 103 and 183 acres respectively; and Great Pélerin island 133 acres. From Mr. Cole's examination all the islands appear to be underlain by the same material, which is a white weathering rock, but darker on a fresh face. It is fine grained and consists of rounded grains of quartz of even texture cemented by a silicious binding material. It is very compact and hard to break with a hammer, but is very brittle, and when crushed, produces a considerable proportion of fines. On the mainland there are also several ridges, between Kamouraska and St. Pascal, which Mr. Cole examined and found to be

*The following notes are mainly taken from a memorandum kindly supplied by Mr. Cole, through the courtesy of Dr. Eugene Haanel, Director of Mines, Ottawa.

of very similar material. Samples of the rock collected by Mr. Cole on the Pélerins islands, gave the following results:

	No. 9	No. 10	No. 11
Silica	98.24	97.77	98.86
Iron oxide	.24	.19	.26
Alumina	1.52	1.27	n.d.
Lime	.10	.10	n.d.
Magnesia	.16	.17	n.d.
Phosphorus	.007	.008	.0003
Loss on ignition	.29	.29	n.d.

(9) (10) Mines Branch Laboratory, Ottawa.
(11) Provincial Government Laboratory, Quebec..

Dr. J. Austen Bancroft, in his report on the geology of the townships of Montauban and Chavigny, in Portneuf county, mentions the occurrence of several areas of Grenville quartzites which might be suitable for use as high grade silica rock.

Mr. Cole visited two of these exposures, viz: on lots 5 and 6, range I, Chavigny township (Sample No. 12) and on lot 1, range V, S.W. of Montauban township (Sample No. 13). This rock, which is of Precambrian age, is massive and very compact. Quarries could easily be opened at both placed examined.

	No. 12	No. 13
Silica	97.67	97.46
Iron oxide	.22	.18
Alumina	1.93	1.09
Lime	.13	.08
Magnesia	.13	.14
Phosphorus	.005	.008
Loss on ignition	.21	.22

In last year's report on Mining Operations in the Province of Quebec, mention was made of the quartzite which is associated with the kaolin deposits of Amherst township. This quartzite is very friable and remarkably free from iron. It contains kaolin, which is mixed with it mechanically. The Canadian China Clay Company have elaborated a process of washing off this kaolin and are producing a very pure white sand.

LIST OF THE PRINCIPAL OPERATORS AND OWNERS OF MINES AND QUARRIES IN THE PROVINCE OF QUEBEC

ASBESTOS

Asbestos Corporation of Canada Limited,
J. McCallum, Secretary, Thetford Mines, Que.

Bell Asbestos Mines,
Hon. Geo. R. Smith, Vice-Pres. and Mgr., Thetford Mines, Que.

Bennett-Martin Asbestos and Chrome Mines, Limited,
Coleraine, Que.

Black Lake Asbestos & Chrome Co., Limited
Black Lake, Que.

Bolton Mining Co., Limited,
209 Davis Bldg., Toronto, Ont.

Louis Croteau,
Belmina, Co. Wolfe, Que.

Eastern Townships Asbestos Co.,
East Broughton, Que.

The Federal Asbestos Co., Limited,
Robertsonville, Que.

The Frontenac Asbestos Mining Co.,
F. W. Ross, Mgr., 92 St. Peter Street, Quebec City.

Imperial Chrome Co.,
P. Poudrier, Mgr., Black Lake, Que.

Jacob Asbestos Mining Co., of Thetford, Limited,
N. Fisher, Mgr., Thetford Mines, Que.

Johnson's Co.,
A. S. Johnson, Mgr., Thetford Mines, Que.

Canadian Johns-Manville Co., Limited,
Asbestos, Que.

The Martin-Bennett Asbestos Mines, Limited,
H. E. Peters, Secretary, Thetford Mines, Que.

Pennington Asbestos Co.,
81 St. Peter St., Quebec.

Quebec Asbestos Corporation,
E. E. Spafford, Mgr., East Broughton, Que.

Windsor Asbestos Mining Company Limited,
Coleraine, Que.

CHROME

J. V. Belanger,
Black Lake, Que.

Bennett-Martin Asbestos and Chrome Mines, Limited,
Fred. Bennett, Manager, Coleraine, Que.

Black Lake Asbestos & Chrome Co., Limited,
J. E. Murphy, Manager, Black Lake, Que.

Aurelien Boyer,
103 St. Francois-Xavier, Montreal.

C. L. Campbell,
602 Royal Trust Bldg., Montreal.

Dominion Mines & Quarries Limited,
Dominion Bank Building, Toronto, Ont.

J. D. Kennedy,
Sherbrooke, Que.

S. E. Melkman,
211 McGill St., Montreal.

Mutual Chemical Company of Canada, Limited,
Black Lake, Que.

Quebec Asbestos & Chrome Co.,
Douglas B. Sterrett, Manager, St. Cyr, Richmond Co., Que.

COPPER

Eastern Mining & Milling Co., Limited,
Bk. of Hamilton Bldg., Toronto, Ont.

Eustis Mining Company,
F. M. Passow, Manager, Eustis, Que.

Maytor Hoppenyan,
Eastman, Que.

John McCaw,
Sherbrooke, Que.

S. E. Melkman,
605 McGill Bldg., Montreal.

A. O. Norton,
W. Jenkins, Manager, Coaticook, Que.

Weedon Mining Co., Limited,
L. D. Adams, Pres., 609 Eastern Townships Bank Bldg., Montreal, Que.

FELDSPAR

British Magnesite Corporation,
605 McGill Bldg., Montreal.

Bush Winning,
N.-D. de la Salette, Que.

S. Carsley & Co.,
151 Notre Dame St. W., Montreal.

E. G. Falls,
624 Gilmour St., Ottawa.

A. Roy Macdonald,
Mattawa North, Que.

GOLD

Eustis Mining Co.,
F. M. Passow, Manager, Eustis, Que.

Martin Gold Mining Co.,
Amos, Que.

Siscoe Mining Corp'n.,
Amos, Que.

Phileas Turcotte,
West Broughton, Megantic, Que.

Zinc Company Limited,
Room 605, Eastern Townships Bank Bldg., Montreal.

GRAPHITE

Bell Graphite Co., Limited,
Box 185, Buckingham, Que.

The Canadian Graphite Co.,
T. W. P. Patterson, Manager, Room 34, Coristine Bldg., Montreal, Que.

Consolidated Graphite Mining & Milling Co.,
Buckingham, Que.

Earle & Jacobs,
Buckingham, Que.

Jas. A. Fumerton,
279 Booth St., Ottawa, Ont.

Graphite Products, Limited,
189 St. James St., Montreal.

McLean & Fitzsimons,
14 Metcalfe St., Ottawa, Ont.

New Quebec Graphite Co., Limited,
R. C. Rowe & C. N. Daly, Managers, Buckingham, Que.

Plumbago Syndicate,
Excelsior Life Bldg., Toronto.

IRON & TITANIC IRON

American Titanic Iron Co.,
c–o Hon. S. N. Parent, Parliament Bldg., Quebec City.

Baie St. Paul Titanic Iron Ore Mining Export Co.,
J. O. Paré, Manager, Baie St. Paul, Charlevoix Co., Que.

The Loughborough Mining Co., Limited,
Sydenham, Ont.

Manitou Iron Mining Co.,
Jos. E. Globensky, 364 University Street, Montreal.

Superior Iron Co.,
7 Clemow Ave., Ottawa.

KAOLIN

Canadian China Clay Co., Limited,
43 Victoria St., Toronto.

MAGNESITE

W. P. Boshart,
Calumet, Que.

J. F. Inglee,
Calumet, Que.

International Magnesite Co.,
708 Eastern Townships Bank Bldg., Montreal.

North American Magnesite Co.,
Room 36, Board of Trade Bldg., Montreal.

Scottish-Canadian Magnesite Co., Reg'd,
211 McGill St., Montreal.

MICA

W. Ahearn, Jr.,
538 MacLaren St., Ottawa.

Blackburn Brothers,
H. L. Forbes, Manager, 212 Creighton Street, Ottawa

Calumet Mica Co.,
Campbell's Bay, P.Q.

Capital Mica Co., Limited,
W. Ahearn, Manager, St. Pierre de Wakefield, Que.

Chabot & Co.,
124 Rideau St., Ottawa.

William Clelland,
Bouchette, Wright Co., Que.

Cross & Wilson,
Cascades, Hull, Que.

Joshua Ellard,
Wright, Que.

H. T. Flynn,
106 Montcalm Street, Hull, Que.

J. B. Gauthier,
Box 226, Buckingham, Que.

J. B. Gorman,
Box 166, Buckingham, Que.

Wm. Gowan,
Holland Mills, Que.

Sylvio Lafortune Mining Co.,
Pointe Gatineau, Que.

The Loughborough Mining Co.,
N. J. Sproule, Manager, c/o G. W. McNaughton, Sydenham, Ont.

Alex. MacLaurin,
522 Board of Trade Bldg., Montreal.

A. Nault & D. Paul,
Maniwaki, P.Q.

O'Brien & Fowler,
Bush Winning, Manager, Beech and Preston Sts., Ottawa.

W. L. Parker,
Buckingham, Labelle Co., Que.

Wallingford Bros.,
Banque Nationale Bldg., Ottawa, Ont.

Wallingford Mica & Mining Co.,
Perkins, Que.

Watts & Noble,
Perkins Mills, Que.

MINERAL WATER

Abenakis Mineral Spring Co., Limited,
W. E. Watt, Manager, Abenakis Springs, Que.

Radnor Water Co.,
Geo. C. Kemp, Manager, Mark Fisher Building, Montreal, Que.

Cyprien Roy,
St. Germain, Kamouraska Co., Que.

St. Leon Mineral Water Co.,
R. W. Nebb, Manager, Toronto St., Toronto, Ont.

Veillet & Frere,
Ste. Genvieve, Batiscan Co., Que.

MOLYBDENITE

Aldfield Mineral Syndicate,
667 Echo Drive, Ottawa, Ont.

L. N. Benjamin,
55 St. Frs. Xavier St., Montreal.

Chabot & Co.,
124 Rideau St., Ottawa, Ont.

Daley Molybdenite Co.,
Superior City, Douglas Co., Wis., U.S.A.

Dominion Molybdenite Co., Limited,
Quyon, Que.

M. L. Foley,
12 Maynard Ave., Toronto.

The Height of Land Mining Co.,
S. P. Wilson, Mgr., 316 St. James St., Montreal.

The St. Maurice Mines Co., Limited,
c/o B. Nielly, Cobalt, Ont.

Standard Molybdenite Company, Limited,
Ottawa, Ont.

Wood Molybdenite Company,
14 Metcalfe St., Ottawa, Ont.

NATURAL GAS

The Canadian Natural Gas Co.,
P.O. Box 2072, Montreal.

The National Gas Co., of Canada,
c/o Mr. E. B. Devlin, Hull, Que.

OCHRE AND IRON OXIDE

Thos. H. Argall,
P.O. Box No. 2, Three Rivers, Que.

Canada Paint Co., Limited,
Jos. Bradley, Manager, Red Mill, Que.

Champlain Oxide Co.,
Lucien Carignan, Manager, Three Rivers, Que.

P. Jobidon,
12 rue Ste. Famille, Quebec City.

Francois Ouellet,
Ste-Gertrude, Nicolet Co., Que.

Paint Products Co. of Canada,
46 Notre Dame St. W., Montreal.

PHOSPHATE

Blackburn Bros.,
H. L. Forbes, Manager, 134 Wellington St., Ottawa.

J. G. Higginson,
Buckingham, Que.

O'Brien & Fowler,
Bush Winning, Manager, Beech and Preston Sts., Ottawa.

Wallingford Mica & Mining Co.,
Banque Nationale Bldg., Ottawa.

Edward Watts,
19 Chestnut Park, Toronto, Ont.

SILICA, ROCK AND SAND

Canadian China Clay Co.,
43 Victoria St., Toronto, Ont.

Cascades Silica Products Company,
103 St. Frs. Xavier, Montreal.

Dominion Glass Company,
Royal Trust Bldg., Montreal.

J. B. Gorman,
Box 166 Buckingham, Que.

J. McClements,
Buckingham, Que.

Montreal Sand and Gravel Co., Limited,
270 Ottawa St., Montreal.

G. Pedenaud,
Buckingham, Que.

Silica Products, Registered,
45 St. Alexander St., Montreal.

SILVER

Eustis Mining Co., Limited,
F. M. Passow, Manager, Eustis, Que.

Weedon Mining Company,
L. D. Adams, President, Weedon, Que.

Zinc Company, Limited,
Room 605, Eastern Township Bldg., Montreal.

TALC

J. N. Martel,
Belmina, Wolfe Co., Que.

Geo. R. Pibus,
Knowlton, Que.

ZINC AND LEAD

Federal Zinc and Lead Co.,
315 Transportation Bldg., Montreal.

The Laurentide Mining Co.,
Notre Dame des Anges, Portneuf Co., Que.

The New Richmond Mining Co.,
New Richmond, Que.

North American Mining Co.,
New Carlisle, Que.

Pierre Tétreault,
Room 416, Power Bldg., Montreal.

Zinc Company, Limited,
Notre Dame des Anges, Portneuf County, Que.

BRICK

The Ascot Tile & Brick Co., Limited,
Ascot Corner, Que.

N. L. Auger,
Ville de St. Tite, Champlain Co., Que.

W. D. Bell,
1286 St. Valier St., Quebec City.

The Citadel Brick & Paving Block Co., Limited,
P. Galarneau, Manager, 320 St. Paul St., Quebec City.

La Compagnie de Briques de l'Islet, Ltee.,
L'Islet Station, Que.

La Compagnie de Briques de Matane,
St. Jerome de Matane, Que.

The Eastern Townships Brick & Mfg. Co.,
Lennoxville, Que.

David F. Hodgins,
Box 87, Shawville, Que.

Stanislas Laliberté,
St. Jean Deschaillons, Que.

Emile Longpré,
St. Félix de Valois, Que.

W. E. Loomis,
Sherbrooke, Que.

The Mack Brick Co.,
260 St. James St., Montreal.

Amédée Mathieu,
Victoriaville, Que.

National Brick Co. of Laprairie, Limited,
10 Victoria Square, Montreal.

Proulx Brothers,
Richmond, Que.

The Sherbrooke Tile and Brick Co.,
Record Block, Sherbrooke, Que.

The St. Lawrence Brick Co., Limited,
71 St. James Street, Montreal, Que.

CEMENT

Canada Cement Co., Limited,
F. P. Jones, Manager, Herald Building, Montreal.

GRANITE

James Brodie,
Graniteville, Que.

Brodie's, Limited,
128 Bleury Street, Montreal.

Joseph Brunet,
663 Côte des Neiges Road, Montreal.

A. L. Bussieres,
St. Henri Village, Levis, Que.

La Compagnie de Granit de Megantic, Limitée,
Lac Mégantic, Que.

Alex. Doyer,
Rivière à Pierre, Que.

Dumas & Frère,
Rivière à Pierre, Que.

Filton & Parmenter,
North Derby, Que.

J. P. Gadbois,
326 Ave. Laval, Montreal.

Lacasse & Duncan,
Graniteville, Que.

J. C. Lacasse,
Beebe, Que.

S. B. Norton,
Beebe Jct., Stanstead Co., Que.

R. A. Rideker,
Graniteville, Que.

Stanstead Granite Quarries Co., Limited,
Beebe Jct., Stanstead Co., Que.

Fortunat Voyer & Freres,
Rivière à Pierre, Que.

Frank Wilkinson,
Beebe, Que.

LIME

Arnaud & Beaudry,
Joliette, Que.

Adolphe Barron,
La Carrière, Que.

Benoit & Fils,
St. Dominique de Bagot.

Arthur Boivin,
Pont Rouge, Portneuf Co., Que.

R. B. Carswell,
Bryson, Que.

Gaspard Desfonds,
St. Cuthbert, Que.

Achille Desilets,
St. Louis de Champlain, Que.

Dominion Lime Co.,
Sherbrooke, Que.

Lucien Doucet,
St. Louis de Champlain, Que.

C. A. Gervais, Estate,
1460 Cadieux St., Montreal.

Emery Héon,
St. Louis de Champlain, Que.

Octave Héon,
St. Louis de Champlain, Que.

Laurentian Stone Co., Limited,
Hull, Que.

Magloire Leclerc,
St. Dominique, Que.

Johnny Lefebvre,
St. Louis de Champlain, Que.

Olivier Limoges,
477 Papineau Ave., Montreal.

Missisquoi Marbles Limited,
Philipsburg, Missisquoi Co., Que.

Thos. McCambly,
Kazubazua, Que.

Montreal Lime Co.,
31 Prenoveau St., Montreal.

Thos. Sharpe,
Coldwell, Que.

Sovereign Lime Company Limited,
Delorimier Ave. and C. P. R. Tracks, Montreal.

Standard Lime Co., Limited,
St. Paul, Joliette Co., Que.

LIMESTONE

Jos. P. Beaudry,
Joliette, Que.

Dr. P. Bertrand,
Shawinigan Falls, Que.

Canada Carbide Company, Limited,
Power Building, Montreal.

Carrière de Québec, Limitee,
Quebec Ry. Building, Quebec City.

Carrière Roberge,
Quebec Ry. Building, Quebec City.

La Cie des Carrières,
St. Marc des Carrières, Que.

La Cité de St-Hyacinthe,
St. Hyacinthe, Que.

La Cité de Hull,
Hull, Que.

The L. Deguire Quarry Co.,
St. Laurent, near Montreal, Que.

The DeLorimier Quarry Co.,
1952 Iberville St., Montreal.

Frank Deraiche,
Chandler, Gaspé.

Deschambault Quarry Corporation,
52 St. Paul St., Quebec City.

The Deschambault Stone Co., Limited,
St. Marc des Carrières, Que.

Edgard Desormeaux,
Cap St. Martin, Laval, P.Q.

Pite Desrosches,
Joliette, Que.

Cyrille Durocher,
5379 Notre Dame St., Montreal, Que.

The Federal Stone & Supply Co., Limited,
213 Sussex St., Ottawa.

E. L. Gravel,
Château Richer, Que.

Institution des Sourds-Muets,
1941 St. Dominique St., Montreal.

Kennedy Construction Co., Limited,
704 Shaughnessy Bldg., Montreal.

The Félix Labelle Quarry Co., Limited,
St. François de Sales.

Georges Labelle,
St. François de Sales, Que.

J. O. Labelle & Cie.
St. François de Sales, Que.

Joseph Lapointe,
Cartierville, Que.

Laurentian Stone Co., Limited,
53 rue Albert, Hull.

Laurin & Leitch,
5 Beaver Hall Sq., Montreal,

Victor Lecrenier,
Cap St. Martin, Cte. Laval.

Olivier Limoges,
477 Papineau St., Montreal.

Narcisse Lord,
St. Jean, Que.

Maisonneuve Quarry Co., Limited,
2855 Boulevard Rosemont, Montreal.

O. Martineau & Fils, Limited,
371 Marie Anne Ave., Montreal.

Jos. D. Naud,
St. Marc des Carrières, Que.

The Penitentiary,
St. Vincent de Paul, Que.

Rogers & Quirk,
1701 Iberville Street, Montreal.

A. Simard,
Chambly, Que.

The St. Laurent Quarry Co., Limited,
Cap St. Martin, Laval Co., Que.

Standard Lime Co., Limited,
Joliette, Que.

Stinson-Reeb Builders Supply Co., Limited,
903 Read Bldg., Montreal.

Talbot, Dussault & Frères,
Levis, Que.

Napoleon Tremblay,
Chenes Avenue, Hull, Que.

Victor Quarry Co.,
147 Mountain Hill, Quebec.

Villeray Quarry Co., Limited,
848 Du Rosaire Street, Montreal.

MARBLE

Missisquoi Marbles Limited,
Philipsburg, Que.

The Pontiac Marble & Lime Co., Limited,
193 Sparks St., Ottawa.

POTTERY

Agricultural Cement Tile & Drainage Co.,
Vaudreuil Station, Que.

W. D. Bell,
1286 St. Valier St., Quebec City.

Canadian Trenton Potteries Co., Limited,
St. John's, Que.

Dominion Sanitary Pottery Co.,
189 St. James St., Montreal.

E. L. Farrar,
Iberville, Que.

David T. Hodgins,
Shawville, Que.

Montreal Fire-Brick Works, Limited,
399 St. Ambroise St., Montreal.

Montreal Terra-Cotta Lumber Co.,
23 Board of Trade Bldg., Montreal.

Standard Clay Products Limited,
St. Johns, Que.

SAND

Atlas Sand Company, Limited,
77 Common St., Montreal.

Jean Ayban,
St. Emelie Junction.

The Bonner Sand & Ballast Co.,
204 St. Nicholas Bldg., Montreal.

Canadian Sand & Gravel Co.,
Richmond and William Sts., Montreal.

Chevrier & Guertin,
St. Joseph de Sorel, Que.

Dominion Sand & Stone Co., Limited,
Common St., Montreal.

Laurentide Sand & Gravel Co.,
11 Sault au Matelot, Quebec, Que.

Montreal Sand & Gravel Co.,
270 Ottawa Street, Montreal.

Royal Moulding Sand & Gravel Co.,
St. Felix de Valois, Que.

Napoleon St. Louis,
Fontarabie, Maskinongé Co., Que.

SANDSTONE

Montreal Sand & Gravel Co., Limited,
270 rue Ottawa, Montreal.

H. F. Routhly,
Haileybury, Ont.

The Sydney Kirby Co.,
213 Sussex St., Ottawa.

SLATE

The New Rockland Slate Co.,
Room 408, Merchants Bank Bldg.,
205 St. James St., Montreal.

STATISTICS OF ACCIDENTS

REPORTED FROM THE MINES AND QUARRIES DURING THE YEAR 1918*

A. O. Dufresne

The year 1917 was qualified as exceptional with regard to the small number of fatal accidents in the mines and quarries of the Province of Quebec, and the year 1918 may be also said to be exceptional, but in an opposite sense. Thus, in 1917, only four fatal accidents were reported, being an average of 0.6 per thousand men employed, while, in 1918, 24 accidents were reported with a total of 29 victims, being a proportion of 4.5 per thousand men, reduced to a basis of three hundred days work each. These figures are really too high for the kind of mining carried on in the Province of Quebec.

Taking the proportion of the number of fatal accidents in the past two years and the number of men working 300 days in the mines and quarries, we get an average number of 2.7. This index number is the same as for the year 1916. To explain such a variation in the number of accidents, one might refer to the law of averages which works out an anticipated number of accidents among a given number of men employed under certain working conditions. Such a law proves accurate when it relates to a sufficiently large number of workmen. On the other hand, the fact must not be overlooked that the year 1918 was remarkable for scarcity of labour; the army, the munition factories and other war works required a very large proportion of workmen. The difficulty of hiring men resulted in a relaxation of discipline. The mine managers being unable to impose the penalty of dismissal for infringements of the regulations, were obliged to tolerate dangerous acts by foolhardy or imprudent workmen. Then contract work was inaugurated in several mines. The loading of derrick boxes at the bottom of the open workings in asbestos mines was paid at so much a load. This system had the advantage of having a larger quantity of ore hoisted up by smaller gangs of men within a given time, but this gain was effected at the cost of the men's safety because they would work under boxes being hoisted, or even on dangerous slopes, in order to fill the boxes more rapidly.

* Translated from the French.

It is difficult to obtain statistics regarding the age of men working in mines. If this information could be had, it would be found that, in 1918, a very much larger number of young men worked in the mines and quarries than in the previous years. This is proved by the age of the victims of fatal accidents, more than 55% of whom were under 25 years of age.

By comparing the number of men working in the mines and quarries of the Province of Quebec during the year 1918—as given in the first column of table I—with the corresponding number in the table of mineral production published in the report for last year, a slight increase in the number of miners will be noted. In 1917 there were 7712 and the number rose to 7791 this year. On the other hand, there was a decrease in the number of men reduced to a common denominator of 300 working days.

TABLE I

Persons employed in the Mines, Quarries and Annexed Mills in the Province of Quebec, during 1918.

Mines, Quarries and Mills	Number of men employed	Number of men calculated on 300 days	
		1918	1917
Asbestos (quarries and mills)	3,710	2,984	3,134
Copper and Pyrite, Silver, Gold (mines and mills)	434	432	308
Chrome (mines and mills)	345	319	240
Feldspar, Kaolin (pits and mills)	61	35	27
Graphite, Mica, Phosphate (pits and mills)	302	125	238
Iron Ore, Titaniferous Ore, zinc and lead	289	234	198
Magnesite	300	304	252
Mineral Water (springs and works)	13	3	4
Molybdenite (mines and mills)	237	196	140
Ochre	95	73	48
Quartz and Silica (pits and mills)	98	32	15
Brick, Pottery (clay pits and mills)	721	344	373
Cement (quarries and mills)	388	472	645
Granite	235	170	111
Lime (quarries and kilns)	203	145	139
Limestone (quarries and dressing works)	815	428	504
Marble, Slate and Sandstone	19	13	56
Sand (pits and rivers)	66	41	65
	7,791	6,350	6,497

This contradiction is merely apparent. As a rule working time in the mines was shorter last year than in the previous one. Thus, for instance, the asbestos mines were worked for only 94% of the possible while, in 1917, there was but little stopping. As there was no strike, the cause of this loss of time must be attributed to last year's rainy weather and to the influenza epidemic in October, which prevailed for three weeks. There was also a considerable decrease in the number of men quarrying and dressing building materials. The *Canada Labour Gazette*, on page 178 of its issue of February, 1919, gives a table of the estimated cost of building materials as indicated by the building permits issued in five cities of the Province of Quebec during the last nine years, which confirm these statistics. It may be said, in passing, that activity in building operations has decreased by 80% since 1913. During the year dealt with in this report, work in quarries was done during a comparatively short period of time.

Out-door work in open pits and quarries must be interrupted by rain in summer and by snow, ice and very cold weather in winter. When a company makes out the statement of its operations at the end of the year, it knows the number of days during which work was partly or entirely stopped. Work will have been done during 100, 200 or 300 days. For comparison purposes two tables will be found in this report showing the number of men employed for varying periods during the year, reduced to a common denominator of 300 working days. To determine this number of 300 day-workmen or "man-year" the operation is very simple and is done by finding the total number of working days and dividing it by 300.

TABLE II

	Number of Workmen	Salaries	Number of day's work	Number of men on 300 days basis
Producing Mines....	5,101	$4,537,857	1,387,548	4,614
Non-Producing Mines	243	102,814	36,982	123
Totals.....	5,344	$4,640,671	1,424,530	4,737

In certain mines and quarries where, owing to the methods adopted, work is continuous from one year to another, it happens that the number of the man-year is greater than that of the men employed. This is due to the fact that there are more than 300 working days.

As a rule, in comparison with the previous year, mining minerals has required a larger number of men than the getting out building materials.

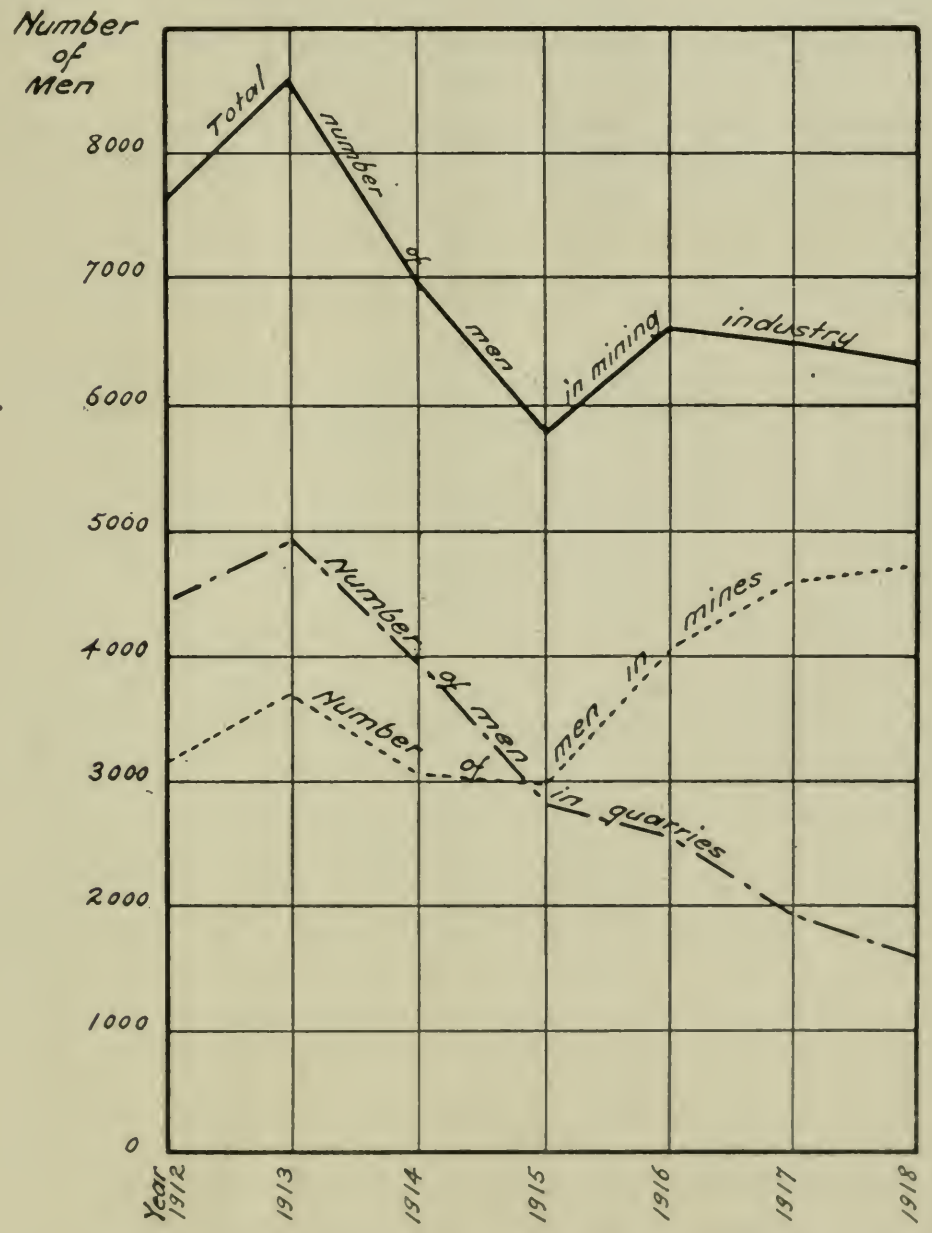

Fig. I—Diagram of number of men employed in mining in Quebec, years 1912 to 1918.

Table No. III, shows that the 6,350 men employed in mining operations is made up as follows: 4,737 in mines and 1,613 in quarries. This was not the case previous to 1913. The quarrying and dressing of building materials at that time represented a more important industry, as regards value and labour, than that of mining minerals. Since then building operations have gradually and rapidly decreased in activity while, owing to the great demand for the raw material required for war purposes, prospecting for and mining mineral deposits have taken considerable development. The resuming of public works and of building operations, it is hoped, will soon restore their lost activity to the quarries in the Province.

The increase of 3% in the number of mine workers is due to the activity in mining deposits of chrome, magnesite, molybdenite, copper-bearing pyrite, iron, lead and zinc.

TABLE III

Workmen in	Number of men on 300 day's basis	Accidents		Total	Per 1,000 employed
		Fatal	Non-fatal		
Mines	4,737	26	187	213	46.4
Quarries	1,613	3	8	11	6.8
Totals	6,350	29	195	224	35.3

The aggregate amount of wages paid in 1918 to workmen employed in the mines and quarries of the Province was $6,149,448, whereof $4,640,671 were paid to those working in mines properly so called. These figures show a considerable increase in the workmen's wages. In 1917 they got $4,868,748 and $3,296,371 respectively. The total wages represent an average of $968 per man in 1918 as against $749 in the previous year, an increase of 30%. The wages given in connection with non-producing mines (Table II) does not include the labour expended on assessment work for retaining rights on mining claims under the provisions of the Mining Law.

By non-fatal accidents the Mines Branch of the Province of Quebec means any accident which incapacitates a man from working for a period of ten days or more, but does not cause loss of life.

As shown by table III., most of the accidents occurred in mines properly so called. Out of a total of 224 accidents, 213 happened in

mines and 26 of this number were fatal. According to the reports received by the Mines Branch, it is estimated that 46.4 men per 1,000 were injured in mines, while the average for quarries is only 6.8. Taking an average per 1,000 men, it will be found that a much larger number of accidents in mines than in quarries was reported to the Mines Branch. Besides the fact of there being more accidents in mines, the mine managers are more particular in reporting accidents than are those in charge of quarries. A great many of the latter are workmen with but little education and who find it irksome to write out these reports. To obviate this drawback, the Mines Branch provides these managers, free of charge, with blank forms, very easy to fill up. Article 2213*a* of the Mining Law requires the person working a mine or quarry, or his representative, when an accident takes place, to send a written notice to the Minister immediately after the accident. Every person not complying with the requirements of this article is liable to the penalties provided in article 2207.

During the year 1918 there were 224 accidents: 213 in mines and 11 in quarries. In the former, 26 were fatal and, in the latter, only three. This makes 5.5 and 1.8 respectively per 1,000 men employed. As stated above, the number of fatal accidents in mines during 1918 is abnormal. Out of the 26 fatal accidents in mines, 10 occurred in underground mines, nine in open pits, five on the surface, and two in annexed plants. In the quarries three fatal accidents have been recorded in open-pits.

Further will be found a description of these accidents. The chief causes of these violent deaths are rock slides; several were recorded as having happened while scaling the walls of cuts or pits. We cannot sufficiently recommend preventing the men from going near them while scaling is being done; moreover, it is the duty of the gang foremen to prevent imprudence on the part of those who are doing the work.

As to the general causes of these fatal accidents, at the Eustis mine, owing to the fact that the ore was mined as far as the shaft in the early workings, and thus leaving it unclosed by a pillar, five men were killed through the falling of a block of rock detached from the roof of an old stope, which slipped into the shaft. Men working at the foot of a slope or on piles of broken stone, especially during thaws, run the risk of serious accidents when they allow the earth to overhang the place where they are

working. Too much stress cannot be laid on the necessity of having movable guards at every level of the shaft in underground mines and seeing that they are always lowered before the signal is given to start the boxes or cages. Gang foremen must watch the drill-runners and make sure that they do not drill too near missed holes. Two men were killed through not heeding this elementary advice. The cable-derricks, with their hoisting of ore over the pits, are a continual source of danger. Unfortunately it too often happens that the men do not think it necessary to get far enough away while the boxes are being hoisted or lowered. If a stone falls or a box drops, an accident occurs which is always fatal. Moreover, signalling is entrusted to quite young boys—often barely 14 years of age—who become inattentive and think only of play while a wrong signal may have serious consequences.

TABLE IV

Accidents in Mines, Quarries and annexed plants of the Province of Quebec for 1918.

	Fatal		Non-fatal		Totals	
	No.	%	No.	%	No.	%
MINES:						
Underground	10	4.5	32	14.3	42	18.8
Open pits	9	4.0	90	40.2	99	44.2
Surface	5	2.2	37	16.5	42	18.7
	24	10.7	159	71.0	183	81.7%
QUARRIES:						
In pits	3	1.3	4	1.8	7	3.1
Surface	0	0.0	4	1.8	4	1.8
	3	1.3	8	3.6	11	4.9%
ANNEXED PLANTS:						
Concentrator	2	0.9	18	8.0	20	8.9
Shops	0	0.0	9	4.0	9	4.0
Power Plants	0	0.0	1	0.5	1	0.5
	2	0.9	28	12.5	30	13.4%
Totals	29	12.9	195	87.1	224	100%

TABLE V

Analysis of fatal accidents in the Province of Quebec, 1918

	Underground	Open Pits	Surface	Total	
				No.	%
MINES:					
Rock falls and slides	7	6	..	13	54.0
Railroads	..	1	3	4	17
Cable-Derricks	..	2	1	3	13
Explosives	2	..	..	2	8
Hoisting	1	..	..	1	4
Electrocuted	..	..	1	1	4
	10	9	5	24	100
QUARRIES:					
Rock falls	..	2	..	2	66.6
Explosives	..	1	..	1	33.3
	..	3	..	3	100
ANNEXED PLANTS:	Concentrators				
Fall	1	..	..	1	50
Belts and Pulleys	1	..	..	1	50
	2	..	..	2	100
Totals	..	..	..	29	..

There is a tendency to do away with this system of hoisting ore with cable-derricks. In several places inclined planes have been made on which the cars run down to the bottom of the pit where they are loaded by means of steam shovels. From another standpoint, this new method causes an increase in the number of railway accidents; but these can be more easily avoided, especially by those who are not imprudent. In the mills there are a great many shafting belts. When these are too near the floor, guards should be put around them so that nobody may come in contact with them unawares. There should be a rule in every mill that no oiling be done until the machines have stopped running. It is true that some parts need to be oiled oftener; if the oil-boxes are near the pulleys, then a wire netting, large enough to prevent the workman from coming in contact with the belting, should be put between the two. Accidents are recorded every year that are due to oiling parts of machinery in motion.

In table VI it will be seen that breaking stone or metal with hammers is responsible for several accidents. These, without being fatal, are very often serious. The victims frequently lose their sight through being struck by small pieces of stone or metal, broken off by the hammer and lodging in their eyes.

TABLE VI

Analysis of non-fatal accidents in Mines, Quarries and annexed Plants of the Province of Quebec, 1918

Mines:	Underground	Open Pits	Surface	Total No.	Total %
Rock falls and slides	16	36	1	53	34
Cable-derricks	..	32	..	32	20
Railroads	..	2	17	19	12
Falls	1	2	8	11	7
Breaking stone	1	9	..	10	6
Falls of object	1	..	6	7	4
Miscellaneous	1	1	5	7	4
Hoisting	5	..	..	5	3
Drilling	1	4	..	5	3
Tramming	4	..	..	4	3
Explosives	1	2	..	3	2
Steam Shovels	..	2	..	2	1
Acetylene lamps	1	..	..	1	1
	32	90	37	159	100%
Quarries:					
Rock falls	..	2	..	2	25
Railroads	..	..	2	2	25
Drilling	..	1	..	1	13
Winch	..	..	1	1	13
Fall	..	..	1	1	12
Crane	..	1	..	1	12
	..	4	4	8	100%
Annexed Plants:	Concentrators	Machine Shops	Power Plants		
Belts and Pulleys	7	..	..	7	25
Miscellaneous	4	1	..	5	18
Machinery	2	3	..	5	18
Falls of object	1	2	..	3	11
Falls	2	..	..	2	7
Breaking metal (with hammer)	..	2	..	2	7
Rock falls	1	..	..	1	4
Circular saw	..	1	..	1	4
Nails	1	..	..	1	3
Steam	..	..	1	1	3
	18	9	1	28	100%

The companies should provide the stone-breakers with goggles and compel them to wear the eye protectors. At first the men will strongly object to them but, in the long run, they will get accustomed to the goggles and will not do without them. Such is the experience in other industries.

In the yearly report on Mining Operations in the Province of Quebec for the year 1915 will be found advice and information on storing and thawing of explosives. The approved methods are there described in detail. And, in the report for the year 1916, pages 101 to 105, suggestions will be found which may help to reduce the number of accidents due to falls of rocks and to cable-derricks. The operators who may be interested in the matter might read these suggestions with some profit.

Table VII. reveals a new state of things. It shows a very large number of accidents among young men and men over 65 years of age. The scarcity of labour compelled the companies to employ boys and old men. These numerous accidents must doubtless be attributed to the inexperience of the young workman and, probably also, to their imprudence.

The workmen should not be entirely blamed for the causes of accidents; some companies are in certain respects too heedless of the safety of their employees. Thus, during the year, the inspector of mines has had to recall the attention of certain companies to paragraph 4 of article 2212 of the Mining Law, which says that "No male child under twenty years shall be employed in working machinery in or near a mine, with the exception of machinery put in motion by horses or other animals, in which case their driver may be sixteen years of age." This provision of the law must be interpreted as forbidding the putting of any young man under 20 years of age in charge of locomotive, motor hoist, etc. This is for the purpose of protecting the lives of men working in the proximity of machines driven by such engines.

Table VIII, shows that most of the accidents caused by rock-falls occurred in the April thaws and during periods of intensive working.

TABLE VII

Age of the Injured, 1918

	15-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	Above 65	Unknown	Total
Non Fatal.....	36	22	35	29	18	11	12	10	4	3	5	10	195
Fatal.....	10	6	5	2	1	..	..	1	3	..	..	1	29
	46	28	40	31	19	11	12	11	7	3	5	11	224

TABLE VIII

ROCK FALLS AND SLIDES, BY MONTH, DURING 1918

NON-FATAL	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Underground	1	3	.....	.....	.....	2	2	1	3	.....	4	.....	16
Open Pits	.....	1	1	6	3	5	7	9	.....	.....	1	3	36
Quarries	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	2
FATAL													
Underground	.....	5	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
Open Pits	.....	.....	1	1	1	1	2	.....	.....	.....	.....	.....	6
Quarries	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	2
Total	1	9	4	7	4	8	13	10	3	0	5	5	69

FATAL ACCIDENTS DURING THE YEAR 1918

No.	Date	Mine or Quarry	Name of Operator	Name of Injured	Age	Occupation	Nature of Injury	Cause of Accident
1	Feb. 20	Eustis.....	Eustis Mining Company	A. Bilodeau.....	19	Trammer.....	Compound fracture of frontal bone, multiple scalp wounds, died on third day.	Rock fell from roof, one side of shaft, near the 40 fathom level and rolled down striking men standing by riding car near 1,800 foot level.
	Feb. 20	do	do	G. Leblanc.....	30	Trammer.....	Crushed to death.....	do
	Feb. 20	do	do	P. Hodoluk.....	35	Trammer.....	do	do
	Feb. 20	do	do	G. Rostagno.....	27	Miner.....	do	do
	Feb. 20	do	do	George Bradley....	59	Trammer.....	do	do
2	Mar. 6	Weedon.....	Weedon Mining Co., Ltd	Napoleon Gagnon..	..	Shoveler.....	Broken neck and fractured skull.	Was killed on 8th level by rock rolling down slope from two levels above.
3	Mar. 21	Weedon.....	Weedon Mining Co., Ltd.	Theophile Rouleau..	25	Scaler.....	Fractured skull and left leg.	Was in stope cleaning away rocks from foot wall when slab fell from pillar.
4	Mar. 21	Quarry.....	F. X. Deraiche.....	Xavier Huard.....	29	Contractor.....	Part of face and nose blown off.....	While springing a hole, twelve feet deep, a cartridge of dynamite exploded.
5	Mar. 26	Beaver.....	Asbestos Corporation of Canada	Emile Smoke.....	38	Labourer.....	Killed instantaneously...	Was buried with earth and stones while working near face in the pit.
6	Apr. 10	Jeffrey.....	Manville Asbestos Co., Ltd.	Athanase Langlois..	24	Brakeman.....	Very severe compound fracture of upper part of right thigh bone. Left foot bones badly crushed.	Run over by loaded rock car.
7	Apr. 12	King.....	Asbestos Corporation of Canada.....	Gedeon Lacroix....	20	Driller.....	Skull opened, death instantaneous.	A slide of rock started from a point 15 to 20 feet above where this man was drilling.
8	May 13	Federal.....	Federal Asbestos Company.	Wilfrid Lefrancois..	20	Dumper.....	Broken spine.....	When hoisting a box of rock, as the box approached the carriage of the cable derrick, the derrick poles broke toward the pit and the sheaves and the top poles fell on the man, killing him instantly.

9	May 27	Jeffrey.....	Manville Asbestos Co. Ltd.	Lucien Larochelle...	23	Driller.....	Crushed between rocks..	Large rock fell on him, while working near face of pit.
10	June 4	Black Lake Mine...	Black Lake Asbestos and Chrome Co. Ltd.	Jeffrey Houde.....	14	Signal boy.....	Electric shock.....	Touched a high tension wire, which had fallen during a big wind storm.
11	June 20	Martin-Bennett....	Martin-Bennett Asbestos Mines Co	Arthur Turmel.....	25	Scaler.....	Killed instantaneously...	While barring down loose rock some went from under his feet, causing him to drop a couple of feet, when rock above him caught and crushed his head.
12	June 26	Federal.....	Federal Asbestos Company.	Joseph Thomas Custeau.	21	Dumper.....	Broken spine.....	Loaded car of train of three cars dropped off the rails onto the ties. The deceased apparently falling from the leading car and being stunned, brake beam underneath car crushed him to death.
13	July 2	Vimy Ridge.....	Bennett-Martin Asbestos and Chrome Mines, Ltd.	Alcide Turgeon.....	20	Driller.....	Spine, left arm and left leg broken.	This man was preparing to drill a piece of loose rock that looked dangerous, he had already tried to bar same down, without success, and had descended on the step on which it rested to put a block hole under it and was working with a pick to start his hole when the rock canted over and pinned him under it.
14	July 8	Caribou Lake.....	Black Lake Asbestos and Chrome Co. Ltd.	Philibert Cloutier...	27	Miner.....	Instantly killed.....	A few hundred tons of rock broke away from side of pit, which buried the man.
15	July 25	Kings.....	Asbestos Corporation of Canada.	France Breton.....	57	Yardman.....	Instantly killed.....	Was run down by a locomotive when walking on the track.
16	July 29	Quarry.....	Elz. Verreault.....	Chas. Chamberland.	56	Labourer.....	Three wounds at the head and to the arm.	While seated on a bench of stone, one rolled away from under his feet and he fell from a height of fifteen feet and was buried underneath a slide of rock.
17	Aug. 21	Beaver.....	Asbestos Corporation of Canada.	Edouard Lavoie....	26	Labourer.....	Instantly killed.....	Derrick box which was being hoisted from the pit, for some unknown reason was lowered and struck the deceased.

FATAL ACCIDENTS DURING THE YEAR 1918

No.	Date	Mine or Quarry	Name of Operator	Name of Injured	Age	Occupation	Nature of Wound	Cause of Accident
18	Sept. 23	Zinc	Zinc Company Ltd.	Alphonse Grandbois	20	Helper	Instantly killed	Drilled into missed hole and was killed with his companion by the blast.
	Sept. 23	Zinc	Zinc Company Ltd	Ernest Delisle	25	Driller	Instantly killed	do
19	Sept. 24	Bell	Bell Asbestos Mines Ltd.	Joseph Poulin	18	Labourer	Posterior part of skull fractured.	Deceased was working in the pit, loading derrick boxes, one of which in hoisting swung around hitting the deceased on the head.
20	Nov. 2	Pennington	Pennington Asbestos Company.	Edmond Toussaint	16	Mill hand	Spine, legs, arm and face injured. When found life was extinct.	Was found round shaft going at rate of 50 R.P.M. Presumed that the victim took ride on elevator belt, while jumping off at top, fell on end of shaft and cloth must have wound round shaft.
21	Nov. 29	Jacobs	Jacobs Asbestos Mining Co. Ltd.	William Cryan	33	Miner	Instantaneous death	Deceased was getting onto the skip at first level, after signal to hoist had been given, when he missed his foot and fell to the bottom of shaft, 280 feet below.
22	Dec. 5	Quarry	Carriere de Quebec Limitee.	Louis Marcoux	52	Labourer	Fractured skull, back crushed, and right leg broken.	The deceased was working at foot of stock pile, the surface of which was slightly frozen, when a slide occurred under which the deceased was buried.
22	Dec. 22	Jeffrey	Canadian Johns-Manville Co. Ltd.	Henry Champagne	20	Brakeman	Instantly killed	Locomotive was backing away from steam shovel, hauling loaded cars of dirt; somehow car dumped pinning him between body and frame of the car.
24	Dec. 28	Fraser	Asbestos Corporation of Canada.	Odilon Plante	23	Labourer	Struck on head by stones	Was thrown in the ore bin by bar which he was holding when stones were dumped from car, and fell in sluice with rocks.

DESCRIPTION OF FATAL ACCIDENTS

February 20th.—At the Eustis Mine, about 4.25 in the afternoon, the second shift of miners were coming up to the surface after their day's work. All the men were in the cage used for bringing the men up the incline. When near the 18th level, the cage stopped and the men heard a great noise. The foreman called to them to jump out, which all did. At the same moment a mass of rock dropped swiftly down killing two men instantaneously and wounding six others, two of whom died after a few hours, and a fifth three days later.

An examination showed that the car was partly destroyed, that the track was badly damaged in some places and some centre posts were broken. The block of stone that caused the workmen's death started from a stope, opening on the main shaft on the west side, and situate at a distance of about 240 feet below the main entrance of the latter. The stone must, therefore, have slid down more than 1,500 feet before striking the workmen. It may be added that the shaft is inclined on an average 45°. While coming up to the surface on the morning of the accident, the foreman of the night shift had noticed a fracture in the top of this stope along the shaft. He reported this to the foreman of the day shift, who sent the timberman to the spot during the forenoon. The latter put a post under the broken part of the roof so as to push it towards the western end of the stope—the opposite way from the shaft—in case of a rock-slide, and thereby prevent any rock from falling into the shaft.

The wall of the stope where the rock-slide took place consists of pale green sericite schists, forming corrugated beds, the fracture surface of which is always unctuous, greasy—and consequently slides away easily. Interbedded with it are some lenticular ore shoots.

As far as one can judge, the stope roof fell down in an easterly direction, that is towards the shaft, over a space of 30 by 60 feet and with a thickness of 4 to 5 feet. The greater portion of the mass of rock that fell remained in the stope, but the great width of the opening on the shaft and the nearness of the mass allowed a large block to fall into the shaft.

Investigation on the spot leads to the conclusion that the rock did not touch the roof of the shaft and, for most of the way, it slipped

on the rails in a direction generally parallel to them; this is shown by the streaks left on the rails and it explains the slight damage caused to the timbering of the shaft. The shaft dips more between the 20th and 21st level; at this spot the block of stone, which had obtained a very great momentum, described a curve and fell further down on the rails, resting on crib work, and then canted into another stope, also opening on the shaft. Everything was destroyed, the rails were twisted, the timber reduced to slivers, the air pipe smashed to pieces, the props holding up the roof of the stope overthrown and broken. About the 24th level, a large piece of schistose rock, heavily mineralized and weighing about three tons, lodged on the side wall of the shaft, at the foot of a strong crib work, after breaking a large prop in the centre of the shaft. Still lower down in the shaft some pieces of the same rock were found which weighed some hundreds of pounds. Taking the nature of the pieces of rock met with along the shaft into consideration, one may express the opinion that the mass of stone that fell into the shaft weighed at least ten tons; that its thickness was small compared with the other dimensions, which explains why it slid instead of rolling on the rails, and went so far down. If the block had rolled, it would have broken and been smashed into small pieces a few hundred feet from where it started; the damage would have been done in the upper part of the shaft and the men would probably not have been killed.

Work had to be suspended for four days owing to this accident.

March 7th.—At the Weedon Mine, Napoleon Gagnon, a shoveler, was killed by a rock that dropped of itself from the roof of a stope and rolled into the level where he was working.

A gang of men were scaling the roof of a stope, at level No. 6, on the east side of the shaft. On the same side in the drift of No. 8 level, Napoleon Gagnon, a new-comer in the mine and inexperienced in mining work, was getting out ore from the platform of a shovelway. The ore stope had previously been broken through levels Nos. 6 and 7, leaving a yawning opening above the eighth level.

On hearing the noise made by a large stone rolling down the two miners sought shelter behind the neighbouring pillars. Gagnon, being over-excited, sought shelter behind a pillar further away and, while passing opposite an opening, he was struck by the piece of rock which came through at the same moment and he was crushed against the side of the drift.

March 21st.—At the Weedon Mine. About 8.30 a.m., Theophile Rouleau was working at level No. 6 when he was struck by a piece of ore, which fell from a pillar, and carried away down to the stope between the 7th and the 8th levels. He was found unconscious and was immediately taken up to the surface and sent by train to Sherbrooke; he died aboard a few minutes before it reached the city. On examining his injuries, it was found that one of his tibia was broken and crushed, the fibula fractured, the ankle bone completely broken, that there were numerous cuts and contusions on the body and a wide fracture at the base of the skull sufficient to cause death. According to the evidence given before the coroner, Rouleau and a companion were cleaning a bench of ore near the foot wall of the east drift of the 6th level, when a large piece of ore flaked off from beneath pillar near the roof. The lower side of this mass of ore is about 30 feet above the drift where the victim was working. He was an expert at scaling and he was allotted this work, which he did very well. Ten days previously he had examined and cleaned the very same pillar from which the stone fell. During several days before he had scaled the roof of the stope. At the end of the previous shift two blasts were fired in that stope, about 50 feet from the pillar in question. Thirty-two dynamite cartridges were used to blast eight holes six feet deep in the wall. It is possible that this may have caused fractures sufficient to make the piece of ore fall down.

March 21st.—At the limestone quarry of F. X. Deraiche, Port Daniel East, Xavier Huard was killed by a dynamite explosion.

The victim was springing a drill hole about 12 feet deep. He had lighted the fuse attached to the dynamite cartridge and let it drop into the hole. The fuse was probably too short and Huard had not time to get far enough away before the explosion. The stones struck him in the face and he died two hours later. He was experienced in firing mines.

March 26th.—At Beaver Mine, Emile Smoke, an Austrian, aged 38 years, was killed by a rock-slide while cleaning the walls of the pit.

The victim was one of a gang of workmen who loaded the boxes of the cable-derrick. The day's work had just begun. In order to lessen any chances of a slide, the gang had set to scale the wall of the cut assigned to it on the upper bench on the east side of the

open-cast pit. About 7.30 a.m. Smoke was getting down a piece of rock when suddenly a large block of stone, weighing nearly 200 tons, delimited by well-defined slip planes, fell down behind him. He was crushed to death; his chest was caved in, his legs were broken in several places. The crushing of the chest caused pulmonary congestion sufficient to produce asphyxia.

April 4th.—In the yard of the Manville Asbestos Company Limited, at Asbestos, Athanase Langlais was crushed by a car of the mine railway as he was trying to connect the air-brake hose of two trucks while the train was in motion.

According to the evidence at the coroner's inquest, the locomotive driver had been ordered to go and get four cars loaded with ore on a siding. The brakeman, Langlais, uncoupled the fourth car from the others and signaled the locomotive driver to back the cars to the mill. This order was carried out and, as the locomotive was at the head of the train, the engineer could not see what was happening until he was told about the accident. Meanwhile the train had run some 50 feet. Langlais was found beside the track opposite the third truck with both legs broken.

He was carried to the company's office where he died a couple of hours afterwards. Before he became unconscious he declared that the accident was not anybody's fault; that, instead of remaining on the end of the last car of the train as required by the regulations, he tried to connect the air-brakes between two trucks while the train was in motion.

VERDICT—Accidental death.

April 12th.—At the King's Mine, Thetford, Gedeon Lacroix, a drill-runner, who was working for a contractor at the bottom of the open cast pit, was putting his drill on a small bench in the north side wall, about 60 feet below the edge of the pit. He was speaking to the foreman when a block of stone fell from a place 15 or 20 feet above.

He was picked up some 130 feet below his working, with his skull split open; his death was instantaneous. No other contusion was found when the body was examined.

The mass of rock that fell probably weighed between two and three tons.

The exact spot where the slide took place had not been specially examined, but workmen passed by there and nothing abnormal had

been noticed that morning. The nearest blast to the spot had been fired two days before at a distance of 30 feet.

The company's regulations require the drill-runner and his helper to examine the wall of the working before placing the drill. However, in order to be of any value, an inspection must cover the whole part above the working to the very top of the pit.

May 13th.—At the Federal Asbestos Mine, Robertsonville, Wilfrid Lefrancois, aged 20 years and 8 months, was instantaneously killed by the falling of the framework supporting a cable-derrick. He was at his place on a platform 30 feet above the ground, and was attending to the unloading of the derrick boxes. About 7.30 a.m., a box loaded with two tons of stone was being hoisted when the posts of the framework broke, owing to a violent and unforeseen jolt, and fell on the platform where Lefrancois stood. The posts are 50 feet in height and carry a steel cable an inch and a half in diameter, well anchored. On this cable moves a carriage under which the box is hauled up or let down from it. The cable, on which travels the carriage, is half an inch in diameter and winds around the hoist drum. Another cable, five-eighths of an inch in diameter, which lowers and raises the box, also winds around the drum. The hoist has a capacity of 80 horse-power. The framework consits of two round spruce masts, each one being securely anchored at the foot and reinforced by cross-stays; they are guyed at the top by four cables. The two masts were broken at the same height (30 feet) from the ground; at that point the diameter of the masts is ten inches. At the inquest a witness stated that during the previous two years two other cable-derrick framework had broken, probably in the same way. It is difficult to know how the accident happened. All that is known is that a box of ore was being hoisted at the time and it seems that the accident occurred at the moment when the box came near the main cable; it would seem that the box struck violently on the carriage, which was steadied. The winding power developed a force which sheared the masts and, the effect of the live load added to the weight of the dead load being greater than the resistance to breaking, it caused the masts to break during the bending.

The remedy for this could be to build head-towers consisting of four masts whose aggregate resistance could withstand the effect of violent jolts to the machinery.

VERDICT—Accidental death.

May 17th.—Lucien Larochelle, 23 years of age, drill-runner in the employ of the Manville Asbestos Company Limited, of Asbestos, was killed by a rock-slide.

He was drilling block-holes on the first bench near the working face, when a large block of stone became detached from the wall not more than three feet from the floor, rolled on Larochelle and crushed him to death.

June 3rd.—Jeffrey Houde, 14 years old, a signaller in the employ of the Black Lake Asbestos and Chrome Company, Ltd. Black Lake, was killed a few minutes after six o'clock in the afternoon while returning home after his work was over. He was electrocuted near the mill by coming in contact with an electric wire charged with a high voltage current (2,200 volts), thrown on the ground by a high wind then blowing. A workman, who had passed some moments before the accident, had not seen any wire on the ground. Between 6.05 and 6.10 o'clock a Russian workman saw young Houde fall and sparks flashing out. He gave the alarm, the switches were shut off and the victim was cared for but he was dead.

The wire thrown down by the wind was merely a temporary line of insulated No. 14 wire, charged with 2,200 volts.

As there were marks of burns on the victim's hands, it may be inferred that he wanted to connect the two ends of the broken wire.

The poles on which the broken wire was strung bore no notice as to danger from the high voltage carried by the wire.

June 20th.—Alfred Turmel, in the employ of the Martin-Bennett Asbestos Co. Limited, of Thetford, was working in the open-pit No. 2, on the east side of the railway, when he was killed by a rock-slide.

Turmel was scaling the south wall of the pit when the accident occurred. The wall is vertical, and as a precautionary measure during his work a cable held by a steel anchor solidly fixed on the surface, was passed under his arm. The victim was working some 40 feet from the bottom, with his feet resting on a small bench of stone. While trying to get down some pieces of loose rock, he removed what may be considered to have been the key of the rocky arch, of which the piece, serving him as a support, formed part. The whole tumbled down. Turmel remained suspended in space at the end of the cable for some minutes, appar-

ently unhurt, when a mass of rock, weighing about a ton, within two vertical fractures spreading out downward, fell upon him.

The shock broke the cable, and the victim was picked up on the bottom of the pit, with his skull and both legs fractured.

June 26th.—Joseph Thomas Custeau, 23 years old, a brakesman in the employ of the Federal Asbestos Company, was killed by a train attending the steam shovel.

The train was made up of a small locomotive and three Standard Western Dump Trucks of a capacity of five cubic yards. The gauge of the rails is 36 inches. The locomotive was at the tail end of the train and the first two cars were full of earth. As the train was running down a slight grade, the brakes were applied to the trucks and the driver had shut off the steam from the locomotive, so that the train was running down the grade by its own weight. The brakesman was sitting on the front of the leading truck, although this was against the rules, when, at a distance of about 200 feet from the steam shovel, the head car jumped off the track and slid on the ties for a length of 28 feet. Custeau was probably pitched in front of it and had not time to pick himself up before the truck reached him. As the axles and brake bar are very low, the latter crushed him against the ties.

The physician who examined the body found a fracture of the vertebral column, of the left shoulder, of the right leg, and of all the ribs on the left side, also a complete fracture of the pelvis. All these fractures produced asphyxia, causing death.

This was the victim's first day of a work that was new to him.

July 2nd.—At the mine of the Bennett-Martin Asbestos and Chrome Company Limited, Coleraine, Alcide Turgeon, 19 years old, was killed by a rock-slide.

A group of workmen were scaling the face of the quarry. Being unable to get down a large piece of rock, weighing nearly three tons, at the top of the wall which they considered to be dangerous, they decided to drill a hole under that rock. While Turgeon was cleaning a small bench right underneath, the rock slipped down on him from a height of 18 inches and crushed him.

He was found to have fractures of the left shoulder and left leg and also of the vertebral column in the lumbar region.

VERDICT—Accidental death.

July 8th.—Philbert Cloutier, 27 years old, was killed by a large slice of the wall of the chrome pit at Lake Caribou falling on him.

The victim was drilling holes with a machine in a small pit at the bottom of the open cut at the far end from the large granite dyke forming the northern part of this excavation. His four companions had just returned to the surface after their day's work when a great slide took place and the wall formed by the granite dyke fell to the bottom.

Investigation of the open working after the accident, revealed a fracture parallel to the dyke, whose existence dated some time back. The work of the water filtering through was observed along the fracture.

The miner who was working right at the bottom was buried by the rock slide and it took his companions four hours to recover his body. He had many superficial contusions on his head and his left leg was broken. Death was ascribed to asphyxia.

July 25th.—At the King Mine, the property of the Asbestos Corporation of Canada Limited, France Breton, 57 years old, a labourer, was struck by a small locomotive while walking on one of the railway tracks in the yard and was killed.

July 29th.—Charles Chamberland, 56 years old, had been working for five or six years in Elzear Verreault's quarry at Giffard, near Quebec.

During the afternoon of the 29th, Chamberland was working with three other men at getting out the stone from a blast that had been fired. He was on a bench near the edge, about 10 or 12 feet above the floor of the quarry. While putting his foot on a detached stone, the latter slid and carried him down to the bottom of the quarry. The falling of the stone and the man caused the fall of another stone, weighing 200 pounds, which followed the victim and struck him on the head, fracturing his skull. When his companions came to his assistance, he was unconscious. A doctor was sent for and the victim died in the ambulance conveying him to the hospital.

August 21st.—Edouard Lavoie, 26 years of age, in charge of the loading of the boxes at the bottom of the open cast pit of the

Beaver Mine, Thetford, was killed by a box of the cable-derrick at the bottom of the quarry.

He had just finished loading a box and, while it was being hoisted up to the surface, he sat down on the spot it had occupied. When it began to come down, and before the hoistman could stop the hoist, the victim was struck on the head.

At the inquest the hoistman testified that the signaller had given the signal—three bells—to hoist. When the box was at a height of from 50 to 60 feet from the bottom, or 20 feet from the carriage of the cable-derrick, two strokes of the bell were given, meaning, "to lower." Apparently the box came down too quickly and struck the victim. The signaller's evidence was different. He denied having signalled two bells, but said he gave only one, meaning "Stop," because the box was getting near the carriage. When he saw the box was coming down, he signalled one bell and, after an interval, another bell.

The signals used at this mine are as follows: three bells: "hoist a few feet"; one bell: "stop at a height of a few feet to steady the box"; three bells: "All right, hoist"; one bell: "Stop the box near the carriage."

Then the box is hauled to the surface. The cause of the accident was attributed either to an error on the signaller's part in giving the signal, or to that of hoistman in working the hoist. Moreover, it was imprudent on Lavoie's part to sit beneath a box that was being hoisted. The victim was found to have a large wound in the scalp and his skull fractured.

VERDICT—Accidental death, with a recommendation to the company to have only older men to run the hoist, as the hoist runner had stated to be 19 years of age.

September 23rd.—Ernest Delisle, age 35 years, and Alphonse Grandbois, 19 years old, fired a ten-hole blast in the face of a drift at level No. 3, 150 feet from the shaft in the mine of the Zinc Company Limited, at Montauban-les-Mines. Delisle was a drill-runner doing job-work, and Grandbois was an experienced miner.

On returning to their work on that Monday afternoon, the two miners found that the previous blast had not done its work as they had expected and that a bench of rock, 18 inches high, remained. The drill was put in position and drilling begun. A few minutes later the drill-bit struck a mis-hole from the previous blast. An

explosion followed and fragments of rock struck the two men, fracturing both their skulls. A third workman who was shovelling, five or six feet from the drill, was also wounded, but slightly. Grandbois was killed instantly and Delisle lived only an hour after the accident.

December 28th.—At the Fraser Mine, East Broughton, Odilon Plante, labourer, aged 23 years, was killed in an ore bin.

The victim was in charge of the unloading of ore cars at the mouth of the ore bin, feeding the crushers. Owing to wrong handling of his bar, he lost his balance and fell to the bottom of the bin just as a truck-load of asbestos-bearing rock was being emptied. The wounds received by Plante were so serious that he died 24 hours later at the hospital in Quebec.

NON-FATAL ACCIDENTS DURING THE YEAR 1918

No.	Date	Mine or Quarry	Name of Operator	Name of Injured	Age	Occupation	Nature of Wound	Cause of Accident
1	Jan. 2	Bell Mine.....	Bell Asbestos Mines, Ltd	Alfred Lapointe....	31	Labourer.....	Chest slightly injured...	Was placing back box of car after dumping contents, when he fell.
2	Jan. 4	Jacob's Mine.....	Jacob's Asbestos Mining Co. Ltd.	Andy Lyon.....	32	Miner.....	Cut on right wrist.....	When working in drift, the injured man cut his wrist on a sharp stone.
3	Jan. 5	Jacob's Mine.....	Jacob's Asbestos Mining Co. Ltd.	Art. Blouin.....	21	Driller.....	Injury to right eye.....	The injured man was breaking rock when a small piece of rock struck him in the eye.
4	Jan. 6	Jacob's Mine.....	Jacob's Asbestos Mining Co. Ltd.	Hugh McEachern...	48	Driller.....	Left ankle broken and left foot injured, also back bruised.	The injured man was working in a deep shaft, about ten feet under the hoisting bucket, when the hoist brake band broke and the bucket fell, striking him on the back and the left foot.
5	Jan. 10	Dominion Mine....	Dominion Molybdenite Co.., Ltd.	Alex. Lance.....	34	Driller.....	Broken index finger badly bruised thumb left hand.	Machine was loose on the side of "Glory Hole" pit, and in shifting the machine the left index finger was caught.
6	Jan. 12	British Canadian...	Asbestos Corporation of Canada, Ltd.	Jos. Turmel.....	16	Cobber.....	Right hand thumb bruised.	Was struck by a piece of rock while he had his hand on box.
7	Jan. 14	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Aime Lachance.....	36	Miner.....	Face and hands burned..	By acetylene gas lamp.
8	Jan. 16	Bell Mine.....	Bell Asbestos Mines Ltd.	Treffle Roy.....	41	Labourer.....	Right knee slightly injured.	While injured was loading cable derrick box in pit a big stone rolled from jam.
9	Jan. 17	Bell Mine.....	Bell Asbestos Mines Ltd.	Emile Plante.....	21	Yardman.....	Toes and right foot bruised.	Injured had his foot caught between crank and frame of locomotive, when shutting off valve of exhaust pipe.

NON-FATAL ACCIDENTS, 1918

No.	Date	Mine or Quarry	Name of Operator	Name of Injured	Age	Occupation	Nature of Wound	Cause of Accident
10	Jan. 19	Weedon Mine	Weedon Mining Co., Ltd.	Earl Edwards	25	Mucker	Right knee injured	While working in stope, boulder rolled down and struck injured.
11	Jan. 21	Jeffrey Mine	Manville Asbestos Co., Ltd.	Edmond Tellier	27	Driller	Lacerated wounds of face and neck, both arms and left eye badly contused.	Loaded hole was drilled into and exploded.
12	Jan. 23	Fraser Mine	Asbestos Corporation of Canada.	Alfred Gagnon	19	Labourer	Fracture of right thigh	Caught by large belt and thrown against the wall of mill.
13	Jan. 23	King's Mine	Asbestos Corporation of Canada.	J. B. Doyon	15	Labourer	Left wrist bruised	Struck by a piece of rock while loading cable derrick box.
14	Jan. 25	Beaver Mine	Asbestos Corporation of Canada.	Theodore Huard	31	Labourer	Left leg twisted	Fell between stone and cable derrick box.
15	Jan. 26	Pit No. 5	The Martin-Bennett Asbestos Mines Ltd.	Jos. A. Vachon	48	Labourer	Left ankle sprained	Had foot caught between big rock and a cable derrick box.
16	Feb. 1	Johnson's Mine	Johnson's Company	Lorenzo Lemieux	16	Labourer	Bruised wrist and bone fractured at the elbow.	Foot slipped while putting on belt on pulley; his hand was caught between belt and pulley and elbow struck ground.
17	Feb. 5	Johnson's Mine	Johnson's Company	Evariste Gagne	—	Labourer	Scalded on leg	Thawing out a frozen steam pipe, steam came out valve suddenly.
18	Feb. 7	Beaver Mine	Asbestos Corporation of Canada Ltd.	Andrew Petry	61	Labourer	Right hand cut	In repairing a car, a part of same fell on his hand.
19	Feb. 16	Jeffrey Mine	Manville Asbestos Co., Ltd.	John Matton	37	Labourer	Laceration and infection over middle tibia.	Struck on shin by switch on railroad.
20	Feb. 18	Beaver Mine	Asbestos Corporation of Canada Ltd.	F. Langlois	49	Labourer	Right foot twisted	Stepping on hard ground.
21	Feb. 19	Stanbridge Quarry	Canada Carbide Co., Ltd	Frank Immoulate	21	Labourer	Compound comminuted fracture of bone and considerable laceration of soft parts small finger.	Hand caught between a box car door jamb and a swinging stone box.
22	Feb. 20	Dominion Mine	Dominion Molybdenite Co., Ltd.	Charles McNamara.	40	Drill helper	Cut to eye-lid and affection of the eye, cut through cornea.	While breaking with a sledge a large piece of rock, a piece flew up striking the injured man in the right eye.

23	Feb. 20	Eustis Mine	Eustis Mining Co	F. Dobish	35	Miner	Compound fracture of elbow, scalp wound.	Man with others were coming up shaft in car when a big rock slid down.
24	Feb. 24	Eustis Mine	Eustis Mining Co	E. Gelinas	23	Trammer	Punctured wound of left leg, multiple contusions.	Man with others were coming up shaft in car when a big rock slid down.
25	Feb. 20	Eustis Mine	Eustis Mining Co	S. Olinik	28	Trammer	Multiple scalp wounds, fracture of orbit.	Man with others were coming up shaft in car when a big rock slid down.
25	Feb. 22	Jeffrey Mine	Manville Asbestos Co.,	John Arsenault	30	Oiler	Little finger crushed, left hand badly crushed and severe contusion up to wrist joint.	While oiling machinery, man got caught in some cogs.
27	Feb. 25	Fraser Mine	Asbestos Corporation of Canada.	G. Plamondon	20	Labourer	Stone fell on ankle	While loading stone, one slipped and fell on his foot.
27	Feb. 28	Jeffrey Mine	Manville Asbestos Co., Ltd.	Nap. Provencher	38	Mill hand	Abrasion and contusion of left forearm, above and below elbow.	While putting on belt was caught by shafting.
29	Feb. 27	Jeffrey Mine	Manville Asbestos Co.,	Ovila Nouris	16	Bagger	A wound one inch long on back of left hand, infected.	Caught hand on a nail while filling bags of asbestos.
30	Feb. 28	King's Mine	Asbestos Corporation of Canada, Ltd.	Nap Pouliot	44	Labourer	Right foot bruised	While loading box, a piece of rock fell from jam and struck his foot.
31	Mar. 1	Jacob's Mine	Jacob's Asbestos Mining Co.	Donat Beguin	26	Carpenter	Two ribs broken and internal injuries.	While pulling on a rope a knot gave way and he fell about 40 feet.
32	Mar. 5	King's Mine	Asbestos Corporation of Canada Ltd.	Adelard Gregoire	19	Labourer	Fourth finger left hand bruised.	While moving a piece of rock it rolled and fell on his finger.
33	Mar. 6	Fraser Mine	Asbestos Corporation of Canada Ltd.	Amede Grenier	34	Crusherman	Shoulder bruised	While loosening rock in sluice, a rock hanging overhead fell.
34	Mar. 7	Jeffrey Mine	Manville Asbestos Co., Ltd.	Ferdinand Lariviere.	—	Mill man	A contusion and abrasion of left cornea, slight sub-conjunctival hemorrhage.	Struck in the eye by a small piece of rock from the cyclone.
35	Mar. 12	Jeffrey Mine	Manville Asbestos Co., Ltd.	Odilon Boudreault	61	Labourer	Severe contusion and laceration of left thumb.	Struck thumb with a hammer.
36	Mar. 13	Pit No. 5	The Martin-Bennett Asbestos Mines Ltd.	Joseph Saindon	26	Labourer	Left eye injured	While breaking stone with a sledge a small piece struck him in the eye.
37	Mar. 16	Pit No. 5	The Martin-Bennett Asbestos Mines Ltd.	Norbert Nadeau	32	Labourer	Left leg, right thigh bruised and left knee sprained.	Was caught between pile of rock and cable derrick box.
38	Mar. 16	King's Mine	Asbestos Corporation of Canada.	Claude Gingras	18	Labourer	Left arm injured	Had his arm caught while replacing a belt on pulley.

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No.	Date	Mine or Quarry	Name of Operator	Name of Injured	Age	Occupation	Nature of Wound	Cause of Acciden
39	Mar. 21	Beaver Mine.....	Asbestos Corporation of Canada.	Alfred Roy.....	18	Labourer.....	Face smashed.....	While drilling, the drill probably struck a mishole and exploded the dynamite.
40	Mar. 22	King's Mine.....	Asbestos Corporation of Canada.	Art. Lemieux.....	36	Machinist.....	2nd. finger left hand bruised.	Caught his finger while moving a heavy piece of machinery.
41	Mar. 23	Lafleur's Pit.....	The Martin-Bennett Asbestos Mines Ltd.	Napoleon Doyon...	30	Labourer.....	Right hip injured.....	The cable derrick box had just gone up and was eight feet above ground when a rock fell from it and struck him on the hip.
42	Mar. 28	Jeffrey Mine.....	Manville Asbestos Co. Ltd.	Antonio Lavigne....	17	Bagger.....	Two severe contused wounds to left wrist and abrasions.	Hand caught in screen while working in Mill No. 2.
43	Apr. 1	King's Mine.....	Asbestos Corporation of Canada Ltd.	B. Landry.....	48	Labourer.....	Cut on forehead and left arm sprained.	While drilling, rock fell from side of pit and struck on head and left arm.
44	Apr. 1	King's Mine.....	Asbestos Corporation of Canada Ltd.	Henri Langval.....	—	Labourer.....	Right arm fractured and cut on head.	While drilling, rock fell from side of pit and struck on head and left arm.
45	Apr. 4	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	S. Morin.....	26	Labourer.....	Contusion of left elbow..	While chaining a rock the chain slipped and struck him on the elbow.
46	Apr. 6	Bell Mine.....	Bell Asbestos Mines Ltd.	Adolphe Leblanc...	55	Labourer.....	Cut above right eye.....	While loading stone in the pit a small stone rolled from the slope and hit him.
47	Apr. 6	King's Mine.....	Asbestos Corporation of Canada Ltd.	Nap. Vachon.....	18	Labourer.....	Thumb cut, right hand..	A piece of rock fell on his thumb, while loading a box.
48	Apr. 6	King's Mine.....	Asbestos Corporation of Canada Ltd.	Philias Lachance...	47	Labourer.....	Right hand bruised and right leg fractured.	While loading a box, a piece of rock rolled from jam and struck him.
49	Apr. 9	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Paul Beaulieu.....	29	Labourer.....	Third finger of left hand bruised.	While loading a cable-derrick, box, a rock fell from side of pit.
50	Apr. 10	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Andrew Marchand..	55	Labourer.....	Right ankle broken.....	The injured man was loading cable derrick box when a heavy rock rolled back on his right ankle.
51	Apr. 16	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd	Eugene Beaulieu....	25	Labourer.....	Fingers bruised.....	The injured man had his fingers caught between chain and rock.

52	Apr. 16	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Benjamin Plourdre..	34	Driller.....	Severe contusion and sprain of right ankle, also contused wound upper part left leg.	While barring down rock, a large piece rolled over both legs.
53	Apr. 22	Beaver Mine.....	Asbestos Corporation of Canada Ltd.	Adelard Daigle.....	33	Labourer.....	Cut at the skull.....	Frozen earth struck him while coupling pipes in pit.
54	May 8	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Elise Lafrance.....	53	Pit boss.....	Left leg sprained.....	Had leg sprained while barring loose rock.
55	May 9	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Henry Young.....	18	Fireman.....	Fracture and contused wounds left foot.	Stepped on rod of locomotive while in motion and foot caught between side-rod and guide of cross-head.
56	May 13	King's Mine.....	Asbestos Corporation of Canada Ltd.	Alfred Cote.....	26	Labourer.....	Left leg bruised.....	A piece of rock fell from jam and struck Cote on leg.
57	May 14	Windsor Mine.....	Windsor Asbestos Co...	.....	—	Teamster.....	Sprained right hand....	In shoveling coal in cars.
58	May 15	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Israel Jutras.....	—	Labourer.....	Contused wound, little finger left hand.	Large piece of rock fell on hand.
59	May 18	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Alex. Fedric.....	28	Miner.....	Right leg badly jammed.	Had leg caught between two cars while coupling them.
60	May 28	Stanbridge Quarry..	Canada Carbide Co.,Ltd.	Alex Rivers.....	35	Labourer.....	Cracked rib, strain of abdominal muscles and internal injuries.	A loaded stone box rested on the covering of a well in the pit. The injured man went to attach chains to the box when both fell through planking into the well.
61	June 1	Pennington Mine...	The Pennington Asbestos Co.	Jos. St. Laurent....	36	Steam Shovel Operator.	Left leg broken, both arms and left leg scalded.	Opening blow-off cock, when bushing near boiler broke, letting water and steam blow over him, in trying to jump out had foot caught in sill of door.
62	June 1	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Louis Morin.....	38	Labourer.....	Laceration of right cornea.	While breaking stone a piece flew striking eye.
63	June 3	British Canadian...	Asbestos Corporation of Canada Ltd.	G. Barabash.....	56	Labourer.....	Toes of left foot bruised.	In lifting a track with a jack it slipped.
64	June 4	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Evang. Guenette...	33	Miner.....	End of left thumb cut off	He was placing his drill in a raise when it fell.
65	June 4	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	John Henry.....	30	Brakeman.....	Fracture of fifth right rib.	Slipped while getting off a car.
66	June 4	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Antonio Paradis....	38	Brakeman.....	A large laceration on occipital region of scalp.	Bumped head on locomotive.
67	June 6	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Arthur Carrier.....	18	Labourer.....	Contused wound of index finger right hand.	Caught between two pieces of iron.
68	June 6	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Arthur Roux.....	50	Jackman.....	Severe contusion of right great toe.	Piece of steel fell on toe.
69	June 12	Laprairie Plant.....	National Brick Co. of Laprairie Ltd.	Hector Audette....	25	LocomotiveDriver	Left leg scalded.....	Bumped into loaded car with locomotive, shock caused blow-off valve to break and allowed steam to escape.

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No.	Date	Mine or Quarry	Name of Operator	Name of Injured	Age	Occupation	Nature of Wound	Cause of Accident
70	June 12	Beaver Mine.....	Asbestos Corporation of Canada Ltd.	S. Jobin.....	47	Carpenter.....	Right leg smashed.....	Had leg caught between derrick and rope.
71	June 12	Weedon Mine.....	Weedon Mining Co., Ltd.	Thomas Bendo.....	31	Driller.....	Left leg broken.....	Loose rock fell on his drill steel and rolled on his leg.
72	June 12	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Alph. Letourneau...	22	Loco. Driver.....	Bruises on body and legs.	Badly squeezed between electric locomotive and car.
73	June 13	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Alphonse Pinette...	32	Yardman.....	Right hand fingers bruised and thumb nail pulled off.	While dumping a car of sand.
74	June 14	British Canadian...	Asbestos Corporation of Canada Ltd.	J. Ferland.....	29	Labourer.....	Index of left hand broken	Finger caught while coupling cars.
75	June 15	Windsor Mine.....	Windsor Asbestos Mining Co., Ltd.	L. Doyon.....	26	Sampler.....	Wound to left hand.....	By some fibre of asbestos.
76	June 15	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Telesphore Hamel..	15	Labourer.....	Severe contusion to head, back and upper third of right leg.	Struck by loaded truck in motion.
77	June 16	Beaver Mine.....	Asbestos Corporation of Canada Ltd.	Ed. Gamache.....	16	Labourer.....	Right foot sprained.....	Bag of asbestos fell on his foot.
78	June 19	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Charles Toutant....	50	Labourer.....	Contusion of left thumb.	Thumb caught and jammed in door.
79	June 19	King's Mine.....	Asbestos Corporation of Canada Ltd.	L. Rochon.....	24	Labourer.....	Left leg injured.....	Struck by rolling stone from jam.
80	June 20	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Geo. Lamiska.....	52	Labourer.....	Left hand bruised.....	Struck by rock falling from side of pit.
81	June 21	Bell Mine.....	Bell Asbestos Mines Ltd.	Roland Roberge....	18	Labourer.....	Cut two inches long on top of head.	When hoistman slacked off, an empty cable derrick box, a small stone, stuck in the bottom of box, fell.
82	June 21	British Canadian...	Asbestos Corporation of Canada.	J. Lessard.....	71	Labourer.....	Right toe bruised, small toe broken.	In rolling a stone, it fell on his foot.
83	June 22	Weedon Mine.....	Weedon Mining Co., Ltd.	Henri Landry.....	—	Driller.....	Right foot badly bruised.	Boulder from stope rolled on him.
84	June 22	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Willie McCrea.....	19	Labourer.....	Finger of left hand bruised.	While filling a cable-derrick box, a rock rolled and caught his finger.
85	June 26	Beaver Mine.....	Asbestos Corporation of Canada, Limited	Laureat Delisle.....	18	Labourer.....	Back sprained.....	Was hit by falling stone.
86	June 27	British Canadian...	Asbestos Corporation of Canada.	P. Guiseppe.....	26	Loader.....	Finger of left hand bruised	Had finger bruised while loading a cable-derrick box.

87	June 28	Delson Plant.....	National Brick Co. of Laprairie Ltd.	Natal Delasante....	23	Labourer.....	Cut on side of right eye and bruise on head.	Was operating winch when in stopping same a cog broke.
88	July 1	King's Mine.....	Asbestos Corporation of Canada, Limited	L. Dussault.....	19	Labourer.....	Right hand cut.....	Cut at right hand by stone.
89	July 2	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Aime Lachance.....	37	Miner.....	Back sprained.....	While loading car he sprained his back.
90	July 2	British Canadian...	Asbestos Corporation of Canada Ltd.	E. Poloni.....	31	Labourer.....	Both hips and legs bruised.	While a loaded cable-derrick box was hoisted he was caught between same and some rocks.
91	July 2	Plant No. 1.....	Canada Cement Co., Ltd.	Joseph Dupres.....	54	Steam Shovel operator.	Right leg broken above ankle.	Stone fell from quarry bank.
92	July 2	Beaver Mine.....	Asbestos Corporation of Canada Ltd.	Eugene Martineau..	26	Labourer.....	Legs bruised.....	Was hit by stone falling from jam.
93	July 4	King's Mine.....	Asbestos Corporation of Canada Ltd.	L. G. Marcoux.....	24	Labourer.....	Left side shoulder and leg injured.	A piece of rock rolled from jam.
94	July 5	Beaver Mine.....	Asbestos Corporation of Canada Ltd.	Napoleon Poudrier.	39	Drill helper.....	Right foot bruised.....	Had foot bruised by horse hoof while moving Calix drill.
95	July 6	Giffard Quarry.....	Carriere de Quebec Ltd.	E. Cochrane.....	32	Driller.....	Foot crushed.....	Drill steel fell on his foot.
96	July 6	Fraser Mine.....	Asbestos Corporation of Canada Ltd.	Ph. Doyon.....	37	Loader.....	Right foot bruised.....	Rock fell on his foot.
97	July 10	Sterrett Mine.....	Quebec Asbestos and Chrome Co.	Arthur Mauri.....	17	Fireman.....	Lost three fingers of left hand.	Hand came in contact with circular saw while sawing wood for boiler.
98	July 12	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	E. Racine.....	45	Blacksmith.....	Right knee injured.....	While sharpening drills he struck his knee with punch.
99	July 15	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Zepherin Boudreau..	18	Brakeman.....	Severe contusion to two fingers left hand.	Caught in draw bar of car.
100	July 15	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	M. Bodner.....	38	Miner.....	Right foot sprained.....	While walking in drift.
101	July 16	Johnson's Mine....	Johnson's Company....	Edmond Goulet....	—	Labourer.....	Contusion and sprain of right ankle.	By stone rolling down from side of pit.
102	July 17	Pit No. 5.....	The Martin-Bennett Asbestos Mines, Ltd.	Philias Gagne.....	42	Miner.....	Left knee sprained and contused.	Was caught between a cable-derrick box and side of pit.
103	July 18	Fraser Mine.....	Asbestos Corporation of Canada Ltd.	Omer Roy.....	36	Labourer.....	Cut on head.....	Struck by cable-derrick box being lowered in pit.
104	July 19	Fraser Mine.....	Asbestos Corporation of Canada Ltd.	Willie Pidgeon.....	26	Labourer.....	Right leg bruised.....	Was caught between cable-box and side of pit.
105	July 20	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Francois Levesque..	643	Labourer.....	Severe contusion of left elbow.	Struck his arm against pulley very forcibly in falling.
106	July 20	Windsor Mine.....	Windsor Asbestos Mining Co., Ltd.	P. Blouin.....	30	Driller.....	Left leg broken.....	By a rail which fell on him while carrying same.
107	July 22	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Wm. Huot.....	24	Loader.....	Right hand cut.....	Had his right hand cut by a piece of sharp rock while loading cable-derrick box.
108	July 22	Beaver Mine.....	Asbestos Corporation of Canada Ltd.	A. Doyon.....	27	Labourer.....	Right leg bruised.....	Rock fell on him.

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No.	Date	Mine or Quarry	Name of Operator	Name of Injured	Age	Occupation	Nature of Wound	Cause of Accident
109	July 27	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Peter Layton.....	35	Driller.....	Right side of scalp cut one inch.	The injured man was placing a pump near shaft when a piece of rock fell from top of shaft.
110	July 30	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	A. Muckavich.uk...	21	Driller.....	Left index finger cut....	Was helping another man to load a car when his finger was caught between two rocks.
111	July 30	Zinc Mine.....	Zinc Company Ltd.....	L. Martel.....	..	Trammer.....	Serious internal injuries to chest.	Man coming off shift up the shaft in skip. sitting position too far out, back below neck came in contact with collar of shaft, bending him forcibly.
112	July 31	Jacob's Mine.....	Jacob's Asbestos Mining Co. ,Ltd.	Matt. Skraynick....	31	Miner.....	Deep cut on left hand....	A rock fell which struck him on the hand.
113	July 31	King's Mine.....	Asbestos Corporation of Canada Ltd.	Joseph Camden....	25	Loader.....	Right leg fractured.....	A rock fell from a jam and struck the injured man.
114	Aug. 1	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Leon Champagne...	17	Labourer.....	Severe bruise right hand,	While shovelling received extensive bruises.
115	Aug. 2	Dominion Mine....	Dominion Molybdenite Co., Ltd.	Wm. E. Doherty...	35	Driller.....	Cracked rib setting up dry pleurisy.	Hit by 1½ inch pipe elbow falling from staging in shaft.
116	Aug. 3	King's Mine.....	Asbestos Corporation of Canada Ltd.	Honore Dubois.....	30	Labourer.....	Sprained left wrist.....	Fell on rock.
117	Aug. 3	Bell Mine.....	Bell Asbestos Mines Ltd..	Nazaire Lemieux...	69	Labourer.....	Toes of right foot slightly bruise.	While working in pit, a rock rolled from side over his foot.
118	Aug. 3	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Omer Vachon.....	27	Contractor.....	Right hand sprained....	He was loading cable-derrick boxes.
119	Aug. 4	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Elphege Cajelet....	34	Brakeman.....	A punctured wound index finger left hand.	While working over locomotive got a sliver into finger.
120	Aug. 7	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Honore Richard....	27	Contractor.....	Right thumb cut off....	The injured man had chained a block of rock and gave signal to hoist up, while holding on to a chain to prevent the rock from swinging when the chain slipped and caught his right thumb between the rock and chain, cutting it off at the first joint.

121	Aug. 8	King's Mine.....	Asbestos Corporation of Canada Ltd.	Desire Richard.....	26	Labourer.....	Pain at right side.....	Caused by overwork moving bags.
122	Aug. 8	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	L. Cartzkan.....	41	Mucker.....	Right leg bruised.....	Got his leg hurt by a rock which fell from top of the pocket he was scaling.
123	Aug. 9	Crane Pit	The Martin-Bennett Asbestos Mines Ltd.	Simeon Chateau....	15	Signalboy.....	Left arm fractured.....	Standing on a wet plaftorm, while on duty he fell on a track below.
124	Aug. 12	Dominion Mine.....	Dominion Molybdenite Co., Ltd.	M. W. Dwyer.....	..	Miner.....	Cut on forehead 2½ inches long, bruises on head and shoulders.	Scaling loose rock from side of pit when rock struck him.
125	Aug. 13	British Canadian...	Asbestos Corporation of Canada Ltd.	Joseph Mercier.....	34	Labourer.....	Right foot bruised.....	Hit by stone rolling from jam.
126	Aug. 13	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Charles Gagnier..,.	38	Engine driver....	Severe contusion of right toe.	Draw bar fell on his foot.
127	Aug. 13	Sterrett Mine.....	Quebec Asbestos and Chrome Co.	Pierre Nadeau.....	72	Teamster.....	Two ribs fractured.....	Was walking beside his single horse wagon and slipped in small hole on rough ground falling against wheel. The hub of wagon wheel struck him in the back on the right side over the lower rib.
128	Aug. 14	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	L. Letourneau.....	23	Mucker.....	Left knee cut.....	The injured man was breaking stone with a hammer when a piece of rock broke off and struck him on knee.
129	Aug. 16	Fraser Mine.....	Asbestos Corporation of Canada Ltd.	Omer Roy.....	22	Loader.....	Cut on back of head....	Struck by rock.
130	Aug. 16	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Noe Prince.....	43	Asst. foreman....	Severe burn, left foot from ankle to toe.....	Stepped into a deep hole of boiling water in pump house.
131	Aug. 17	Fraser Mine.....	Asbestos Corporation of Canada Ltd.	ErnestJacques.....	35	Loader.....	Right leg bruised.....	Was struck by piece of rock falling from jam.
132	Aug. 19	King's Mine.....	Asbestos Corporation of Canada Ltd.	Alp. Labrie.....	27	Labourer.....	Small finger left hand bruised.	Was struck by stone falling from jam.
133	Aug. 19	King's Mine.....	Asbestos Corporation of Canada Ltd.	Ferdinand Fabre...	49	Labourer.....	Small finger left hand cut.	While loading a cable-derrick box, a piece of rock struck his hand.
134	Aug. 21	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Octave Roy.....	48	Machinist.....	Right side of body injured by falling and striking on a bolt.	The injured man was taking down a dryer when his foot slipped and he fell.
135	Aug. 21	King's Mine.....	Asbestos Corporation of Canada Ltd.	Louis Lessard.....	35	Labourer.....	Fourth finger right hand bruised.	Hit by stone while loading a cable-derrick box.
136	Aug. 23	Jeffrey Mine.....	Manville Asbestos Co., Canada Ltd.	Arthur Boudreau...	27	Locomotive driver	Severe contused wound middle finger, left hand.	Large piece of rock fell on his finger.
137	Aug. 23	King's Mine.....	Asbestos Corporation of Canada Ltd.	Albert Beaudet....	33	Labourer.....	Wound right hand third finger.	Piece of rock fell from jam.

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No.	Date	Mine or Quarry	Name of Operator	Name of Injured	Age	Occupation	Nature of Wound	Cause of Accident
138	Aug. 31	Beaver Mine.....	Asbestos Corporation of Canada Ltd.	Omer Corriveau....	30	Labourer.....	.....	While loading a cable-derrick box he was struck by another box which was lowered.
139	Sept. 5	British Canadian...	Asbestos Corporation of Canada Ltd.	Ludger Pelletier....	27	Labourer.....	Bruises on left hand.....	While loading a cable-derrick box, he was hit by a stone thrown in by his partner.
140	Sept. 10	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	James Morrison....	31	Labourer.....	Left hand pierced by nail.	He was working on a platform when his foot slipped, and he fell on a nail.
141	Sept. 11	King's Mine.....	Asbestos Corporation of Canada Ltd.	Alvarado Bisson....	17	Labourer.....	Right-hand bruised.....	Injured while coupling cars.
142	Sept. 14	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	N. Chamberlain....	18	Shopman.....	Right foot seriously bruised.	While drilling holes in a steel plate it fell on his right foot.
143	Sept. 17	Jeffrey Mine.....	Manville Asbestos Co., Co., Ltd.	Benj. Laurence.....	33	Fireman.....	Severe lacerations, middle and ring fingers right hand.	While dumping dirt his finger was caught by car.
144	Sept. 17	King's Mine.....	Asbestos Corporation of Canada Ltd.	Emile Paradis.....	15	Labourer.....	Wound at index finger left hand.	Struck his hand with hammer while cobbing crude.
145	Sept. 18	British Canadian...	Asbestos Corporation of Co., Ltd.	Adolphe Ardoin....	71	Labourer.....	Back sprained.....	While digging holes for foundadation.
146	Sept. 19	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Alex Frederic.....	29	Mucker.....	Second and third fingers of left hand bruised.	Struck by falling rock.
147	Sept. 19	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Basile Philipchuk..	36	Mucker.....	Left leg broken above knee.	While working at foot of a raise a big rock fell.
148	Sept. 23	Jeffrey Mine.....	Manville Asbestos Co., Ltd.	Alex Laforest.....	44	Labourer.....	Contusion and sprain of left hand and forearm, and number of abrasions.	Caught between belt and pulley.
149	Sept. 23	Zinc Mine.....	Zinc Company Ltd.....	Eugene Ketchie....	20	Mucker.....	Slight head wounds.....	Machine man drilled into a mishole.
150	Sept. 28	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Wm. Cryan.....	33	Miner.....	Nose injured by falling rock.	While dumping cars in a drift, a stone fell from the top and struck him on the nose.
151	Oct. 2	British Canadian...	Asbestos Corporation of Canada, Ltd.	N. Cloutier.....	20	Labourer.....	Left knee sprained.....	In jumping from car.
152	Oct. 3	Beaver Mine.....	Asbestos Corporation of Canada Ltd.	Octave Brochu.....	23	Labourer.....	Right leg broken.....	Was struck by cable-derrick box.
153	Oct. 4	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Henri Morissette...	58	Labourer.....	Stone dust in right-eye...	While breaking stone with a hammer some small pieces flew into his eye.

154	Oct. 8	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Albani Champagne.	..	Labourer.....	Stone dust in the left eye.	Was breaking stone with a hammer and some small pieces of stone flew into his left eye.
155	Oct. 12	Pit No. 5.....	The Martin-Bennett Asbestos Mines Ltd.	Moise Leblond.....	54	Miner.....	Left eye badly inflamed..	While breaking stone a very small particle flew into his eye. He went to the doctor only a few days after.
156	Oct. 22	Lime Ridge.....	The Dominion Lime Co..	L. Sauvage.....	17	Labourer.....	Fracture of two ribs....	Was dumping cars of rock on trestle, became dizzy and fell about thirty feet.
157	Oct. 25	King's Mine.....	Asbestos Corporation of Canada Ltd.	Fortunat Mercier...	18	Labourer.....	Index right hand bruised	Fingers caught while coupling cars.
158	Oct. 26	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	R. Roberge.....	16	Machinist.....	Right eye injured.....	While removing babbit from a bearing a piece of same went into his eye.
159	Nov. 5	Jeffrey Mine.....	Canadian Johns Manville Co., Ltd.	Jos. Mace.....	55	Labourer.....	Fractured thumb.....	While working around steam shovel.
160	Nov. 7	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	L. Gagne.....	19	Miner.....	Right eye injured.....	While breaking rock with a hammer a piece of rock flew off and struck his eye.
161	Nov. 13	Beaver Mine.....	Asbestos Corporation of Canada Ltd.	Flavien Savard.....	43	Labourer.....	Right thumb cut.....	In loading a cable-derrick box.
162	Nov. 13	Jeffrey Mine.....	Canadian Johns Manville Co., Ltd.	Oscar Mitchell.....	26	Millwright.....	Fracture of third finger, left hand	Glove was caught in gear.
163	Nov. 16	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Louis Marois.....	52	Millwright.....	Right eye injured.....	While punching a hole through a steel plate a piece of tool broke.
164	Nov. 18	King's Mine.....	Asbestos Corporation of Canada Ltd.	Joseph Couture....	65	Labourer.....	Left arm bruised.....	Was struck by piece of iron.
165	Nov. 23	Dominion Mine....	Dominion Molybdenite Co., Ltd.	Joseph Daoust.....	28	Driller.....	Cut on left hand.....	Standing on pump which was being hoisted when pulley block dropped on his left hand.
166	Nov. 26	Jeffrey Mine.....	Canadian Johns Manville Co., Ltd.	Elias Pepin.....	15	Labourer.....	Laceration of right thumb with evulsion of nail.	Block of rock fell on hand.
167	Nov. 27	Fraser Mine.....	Asbestos Corporation of Canada Ltd.	Alp. Lapointe.....	49	Labourer.....	Bruised toe.....	Rail fell on toe.
168	Nov. 27	Dominion Mine....	Dominion Molybdenite Co., Ltd.	Isidore Gosselin....	24	Mucker.....	Shoulder bone badly bruised.	While scaling down side of pit a piece of rock fell on his shoulder.
169	Nov. 27	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Arthur Caron.....	26	Mucker.....	Face and back injured...	Rock fell from roof of tunnel.
170	Nov. 27	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Ovide Fugere.....	52	Carpenter.....	Head cut, 1½ inch long..	While making a rock bin underneath a trestle, a small rock fell from trestle.

NON-FATAL ACCIDENTS, 1918

No.	Date	Mine or Quarry	Name of Operator	Name of Injured	Age	Occupation	Nature of Wound	Cause of Accident
171	Nov. 28	Bell Mine	Bell Asbestos Mines Ltd.	Jos. Fortier	26	Labourer	Left elbow bruised	While loading a cable-derrick box he jammed his finger between two rocks.
172	Nov. 29	King's Mine	Asbestos Corporation of Canada Ltd.	Tel. Theriault	56	Labourer	Right hand and wrist sprained.	Fell from a pile of wood while unloading car of lumber.
173	Nov. 30	Jacob's Mine	Jacob's Asbestos Mining Co., Ltd.	John Rodue	27	Driller	Right instep fractured	By a fall of rock.
174	Nov. 30	Jacob's Mine	Jacob's Asbestos Mining Co., Ltd.	John Kedzull	27	Driller	Back and right leg muscles bruised.	By a piece of rock falling from roof of a drift.
175	Dec. 3	Bell Mine	Bell Asbestos Mines Ltd.	Telesphore Guay	67	Labourer	Left leg bruised	Working around steam shovel had foot jammed by a chained piece of frozen ground.
176	Dec. 5	Brick Yard	Citadel Brick & Paving Co., Ltd.	Auguste Bacon	49	Labourer	Three ribs fractured	Was caught underneath a slide in clay pit.
177	Dec. 5	King's Mine	Asbestos Corporation of Canada Ltd.	Wm. Dubois	45	Labourer	Cut on nose	Was hit while working with crowbar.
178	Dec. 5	Jacob's Mine	Jacob's Asbestos Mining Co., Ltd.	Antoine Lachance	18	Driller	Both legs and face bruised	Slipped from side of dump.
179	Dec. 6	Jeffrey Mine	Canadian Johns Manville Co., Ltd.	Napoleon Mailhiot	34	Driller	Sprain right ankle	While moving drill slipped.
180	Dec. 6	Jeffrey Mine	Canadian Johns Manville Co., Ltd.	Benj. Ploudre	35	Toolkeeper	Punctured wound left hand.	In sorting tools.
181	Dec. 10	Beaver Mine	Asbestos Corporation of Canada Ltd.	Alfred Carrier	24	Labourer	Right leg smashed	Was struck by cable-derrick box.
182	Dec. 14	Jacob's Mine	Jacob's Asbestos Mining Co., Ltd.	A. Mokavitchuk	21	Driller	Body badly squeezed between skip and its bail.	Six men, after shift were hoisted up from bottom of shaft to surface, Hoistman did not stop skip at surface level, and hoisted the men to the skip dump, in the head-frame. None of them were dumped out.
183	Dec. 16	Beaver Mine	Asbestos Corporation of Canada Ltd.	Jos. Clavet	43	Labourer	Back twisted	Struck by cable-derrick box which was being lowered.
184	Dec. 16	King's Mine	Asbestos Corporation of Co., Ltd.	W. Beauregard	19	Labourer	Cut on the head	Rock fell from side of pit.
185	Dec. 16	British Canadian	Asbestos Corporation of Canada Ltd.	Eugene Grenier	34	Labourer	Bruised back and hips	Struck by rock falling from side of pit.

186	Dec. 16	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Robert Tyrell.....	36	Loader.....	Finger nail pulled off of left index-finger.	The man was closing car door, when he jammed finger between frame and door.
187	Dec. 18	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Jos. Bilodeau.....	19	Sweeper.....	Right hand bruised.....	While removing rock from pulley, hand caught between it and post.
188	Dec. 20	Johnson's Mine....	Johnson's Company....	Onesime Marcoux..	25	Hoistman.....	Hurt on side and sprain of ribs.	Slipped and fell against iron gear.
189	Dec. 21	Beaver Mine.....	Asbestos Corporation of Canada Ltd.	Evariste Nantel....	53	Labourer.....	Breast bruised.	Struck by car while dumping same.
190	Dec. 24	King's Mine.....	Asbestos Corporation of Canada Ltd.	Lucien Daigle.....	28	Carpenter.....	Right shoulder and arm sprained.	Fell on ice.
191	Dec. 27	Weedon Mine.....	Weedon Mining Co., Ltd.	Louis Tetreault....	39	Timberman.....	Cut on head, head and back squeezed.	Coming up on the skip bail facing hanging wall, near fifth level his head struck hanging roller, and fell over the skip, passed at No. 5 flat in that position had his head and back squeezed between flat and skipped.
192	Dec. 28	Pit No. 5.....	The Martin-Bennet Asbestos Mines Ltd.	Sylvain Perron.....	39	Foreman.....	Left leg smashed just above knee.	While standing near side of pit a big rock fell which squeez- his leg against an other.
193	Dec. 30	British Canadian...	Asbestos Corporation of Canada Ltd.	Geo. Metivier.....	42	Labourer.....	Right foot bruised.....	Hoisting block slid and dropped on injured man's foot.
194	Dec. 30	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	Henri Giroux.....	58	Yardman.....	Right foot bruised.....	While lifting a piece of timber it slipped from his hands.
195	Dec. 31	Jacob's Mine.....	Jacob's Asbestos Mining Co., Ltd.	O. Dupont.....	29	Driller.....	Third finger of right hand bruised.	While drilling his machine broke and finger was caught between broken pieces.

DYNAMITE THAWING HOUSE OF THE ASBESTOS CORPORATION OF CANADA, LIMITED

The Asbestos Corporation of Canada, Limited, which operates the following four asbestos mines, namely: the King and Beaver Mines at Thetford, the British Canadian Mine at Black Lake and the Fraser Mine at East Broughton has, during the year, remodelled and standardized the system of thawing dynamite in all its mines. The new installations differ from one another only as regards the quantity of dynamite that can be thawed at the same time, the dimensions of the buildings and the method of heating water. At the Beaver and Fraser Mines, electric heating is used and, in the two others, heat is produced by coal. These plants are modern and in accordance with safety conditions required in handling explosives. An idea of the quantity of dynamite that has to be thawed, can be had from the fact that, on some days, as many as 10,000 cartridges are used in blasting operations. With a view to making better known the proper methods of thawing dynamite it was deemed advisable to give here a short description of the practice followed by the Asbestos Corporation of Canada, Limited. For those who intend to improve their own method, the following description may be taken as model; it is practically the installation as seen at the British Canadian Mine at Black Lake.

The principle consists in thawing dynamite by water heated in a furnace placed in a second building, sufficiently far to remove all danger of fire for the first building. The cartridges are put on lath shelves but in such a manner as not to be over the radiators. Both buildings are well lighted and kept very clean. To avoid all danger from fire the furnace supplying water to the radiator of the dynamite heater is at a distance of at least 75 feet. The connecting pipes are four feet underground.

Much attention was given at each of these mines to the choice of a proper site for these plants. They are at a minimum distance of 400 feet from any mill or house, but, as far as possible, in a place easy of access from the mines. The first building, that in which the dynamite is thawed, is a balloon-frame one with a two-gable roof. The rectangle measures 12 by 13 feet and the walls are 7 feet 6 inches high. The coping is 12 feet above the floor. The frame consists of 2 by 4 inch scantling spaced 16 to 18 inch and corner posts 4 by 4

Asbestos Corporation of Canada Ltd.—Thawing Plant for Explosives at British Canadian Mine, Black Lake, Que.

Asbestos Corporation of Canada Ltd.—Thawing Plant for Explosives at King's Mine, Thetford Mines, Que.

inches. One inch boards are nailed on both sides of the framing and on them are nailed one inch wooden battens to hold reinforced and tarred paper—known in the trade as "Clinton Sheathing"—under a fire-proof coating. The paper is reinforced with welded wire netting; the coating is a mixture of cement, sand and asbestos dust. The roof is of the same materials. The floor is of 2 inch boards and the beams rest on a foundation of concrete blocks in the shape of truncated pyramids sunk four feet underground. An ample supply of light comes through the two 36 inches windows on each side, and is reflected by the whitish grey colouring of the inner walls. Communication from the outside with the main room of the building is had by a vestibule with four foot sides, which prevents variations of temperature inside.

In the middle of the room is a closet 9 feet long and 44 inches wide in the upper part with a projection or shoulder 12 inches wide on both sides to a height of 36 inches from the floor, under which are the two hot water radiators producing the heat required for thawing the dynamite. Above the projections are six shelves made of battens $1\frac{1}{2}$ inch wide, laid at one inch intervals on 2 by 4 cross pieces. The spaces between the battens allow the hot air to circulate. Access to all parts of the closet is had by means of a sufficient number of doors on each side. At the end of the closet is an opening by which the floor can easily be cleaned of the saw-dust moistened with nitro glycerine that may exude from overheated cartridges. The heater or radiator comprises two sections of about 50 feet of iron piping an inch and a half in diameter. The hot water comes from another building. A thaw-house like this can thaw about 3,000 cartridges at a time.

The favourable features of such a building are: (a) its great distance from any other building while being at a reasonable distance from the mine; (b) the absence of all fire in the building; (c) facility of regulating heat; (d) the impossibility for nitro-glycerine exuding from the cartridge, of touching the heaters; (e) the inside space, light and cleanliness; (f) the facility for the thawing of dynamite; (g) protection against dampness.

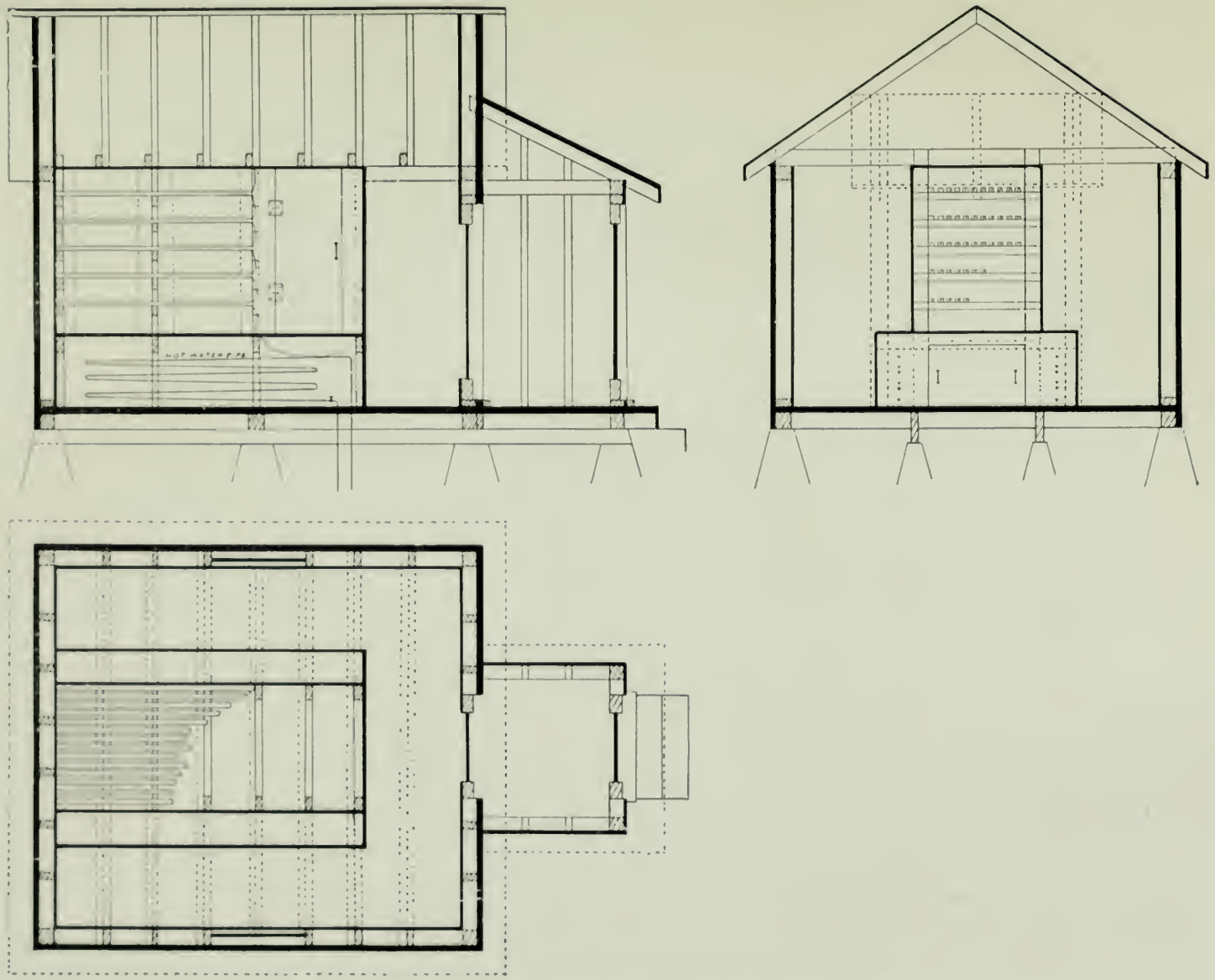
The second part of the plant is in another building 75 feet away from that where the thawing is done. It is rectangular in shape like the first one, but has two stories, one being the ground floor and the other a basement. Its dimensions in length and width are as follows: 9 feet by 13 feet 6 inches. The height from the cellar to

the ridge of the roof is 21 feet. The plan of the building is the same for the upper part as in the case of the first building. At the King Mine the floor is a 6 inch concrete slab instead of 2 inch boards. The basement is eight feet deep; the walls and floor are of concrete, the former being twelve inches thick at the foot and eight inches at the top. There is an iron staircase, a coal bin, and a furnace which heats the water required for thawing the dynamite in the first building.

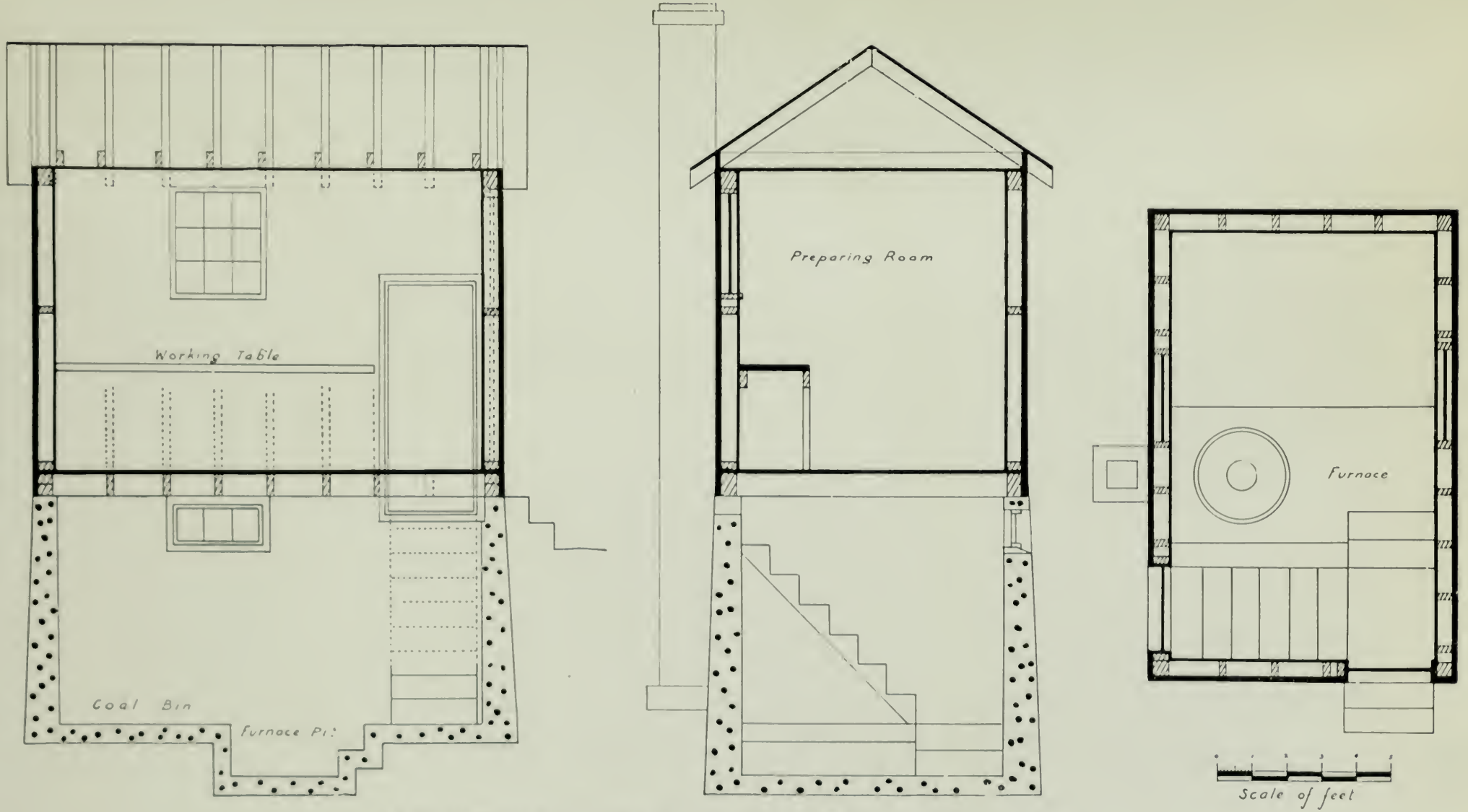
It will be seen by the sketch on the next page that there is no means of access from the ground floor to the basement, each story having its own entrance from outside. This has been done to have more room on the ground floor for the person in charge of the explosives. This place is furnished with a large table covered with an asbestos sheet and there is also a window 36 inches square. Here all the work in connection with blasting is done. The fuses being cut to the required length, a fulminate cap attached to the end of each one and record kept of all issues of explosives. This room is heated by a hot-water radiator.

At the Beaver and Fraser Mines, the coal-burning furnace has been replaced by an electric heater inserted in the heating apparatus and, as in the case of the other plants, placed in a special building at a sufficient distance from the thawing-house. This is a 3-heat Hotpoint heater. When on a 110 volt circuit, it requires an energy of 27.5 amperes.

Such a system of thawing dynamite is very recommendable and too much stress cannot be laid on its most important feature, namely: The fact that there is no fire in the building where the dynamite is thawed. Every system that does not provide a sufficient method of protection against fire must be abandoned at once. Buildings containing a stove, a furnace or inflammable matter must not be used for receiving any dynamite to be thawed.



Asbestos Corporation of Canada Ltd.—Thawing House



Asbestos Corporation of Canada Ltd.—Furnace Building for Thawing House.

SANITARY MEASURES IN MINING CAMPS

A. O. Dufresne

From time to time, private individuals or companies undertake to mine recently discovered deposits. As these mineralized deposits are nearly always at a rather considerable distance from villages, one of the first things to be done by the persons in charge of the operations is to see to the workmen's lodgings. During the first years, the men generally live together, thus having two buildings at their disposal; the first has two good-sized rooms: a sleeping-room and a smoking room; the kitchen and dining room are in the second. When development work is sufficiently advanced and it is foreseen that mining operations will last several years, lodgings are built for the workmen's families.

Of late years, managers have given much attention to the miner's safety when at work. This praiseworthy policy has produced good results. When the interest taken by employer with regard to proper labour conditions is realized, the workman gains confidence in those who are over him; the latter are sure of their employees' loyalty and every year's balance sheet shows an increase in the number of working hours per man. But results cannot be so complete if the interest taken by the managers is confined to the works. The sanitary conditions under which the workman and his family live, have a greater influence than one imagines on the yield per man. If the workman is not in good health, if there is any sickness in his home, the result will be either decrease in work or a state of mind which will cause a proportionate decrease in yield.

In camps owned by companies or situated in unorganized districts, the duty of seeing to the salubrity of their workmen's dwellings and to the general sanitary conditions of the camps, devolves upon the managers. By eliminating danger of sickness and contagion, they enable the workmen and their families to be sure of pleasant living conditions in the camp, and in return the owners get the best men for their work.

Dwellings

The conditions for a good dwelling lie in the choice of the site, the manner of building, comfort, sanitation, cleanliness and water supply.

The first consideration will be directed to the site of the dwellings. A high and dry spot at a good distance from stagnant water will be chosen. The houses will be so faced as to get the greatest amount of sunlight. The windows will be large so as to have plenty of light. The houses will be built so as to be warm in cold weather. A system which gives good results in the Province of Quebec, where the thermometer drops to 30° Fahr. below zero, consists in having a double wall with air space between on the four sides of the building made with a double lining of tongued and grooved one inch boards, with tarred paper between, nailed on scantling.

Comfort in a house depends upon the degree of heat (60-65° Fahr.) and of humidity of the inside atmosphere. The regulations of the Superior Board of Health of the Province of Quebec require that "the cubic air space of all the rooms of a lodging, taken collectively, to be sufficient to allow each eventual occupant at least 300 cubic feet of space, and that the floor space be at least 32 square feet for each occupant."

In some places 600 cubic feet of air are required for each person. The windows must be so arranged as to allow all the rooms in the house to be aired.

In the best camp boarding houses there are no longer any wooden bunks; these have been replaced by iron beds with spring mattresses. The former should not be tolerated in well organized camps.

Water Supply

A good supply of drinking water is indispensable. Great precaution must be taken in securing this; regular inspections must be made to make sure that there is nothing in the wells, springs or streams from which the water is obtained, that can contaminate it.

Removal of Garbage, Etc.

To assure cleanliness around the various buildings, galvanized iron receptacles should be provided for receiving garbage and slops. These must be emptied periodically and their contents be destroyed preferably by incineration.

Article 52 of the Superior Board of Health of the Province of Quebec orders that all garbage be burned or buried at least one foot underground and at a distance of over one hundred feet from wells.

By article 55 it is forbidden "to deposit dead animals, garbage or filth in rivers, springs, cisterns, reservoirs, streams and ponds.

Stables

Stables must, of all necessity, be kept at a distance from dwellings, the minimum being 150 feet.

Privies

There is a problem in connection with building dwellings in unorganized districts to which much attention must be given, and that is the installation of privies. These may be either outside or inside the house. The former are chiefly found in mining camps; and are placed in a small building somewhere behind the house at the back of the lot. In most instances, these privies consist of a wooden box covering a hole in the ground two or three feet deep. The upper part of the box, which serves as a seat, has an opening with a cover, some ten inches in diameter. This kind of privy is sufficient, from a sanitary standpoint, for a temporary camp on condition that precaution be taken to keep flies out by proper wire screens and the emanation of bad smells be prevented by throwing enough earth on the excrements. Lime, thrown in the pit once a fortnight, will destroy noxious microbes.

Sanitarians condemn this pit system as unsanitary for permanent camps because it may lead to contamination of the underground waters. In some cases, pits have been replaced by portable receptacles beneath the seat, such as: barrels, boxes or buckets, which are replaced at regular intervals. The contents are incinerated. In other cases, the receptacles are fixed and these are preferably built of concrete below the surface. The organic matter or excrements being periodically removed.

The best installations are those which allow natural fermentation of the feces. This is effected through the presence of certain microbes whose opportune role consists in eliminating putrifactive organic matter from the surface of the soil. This transformation takes place in concrete pits. The latter have two basins; in the first one the water undergoes anacrobic fermentation in a quantity of water covered with a scum which one must be careful not to break or tear. The accumulated matter is thus completely liquidified. When the level of this eminently septic liquid

reaches a certain height the overflow runs off into the second basin whose contents may be disinfected or spread intermittently on the purification farm.

In many places running water is at hand in the house, either pumped into a tank by hand or supplied by water-works when the undertaking has assumed development and importance as to justify the construction of the same. In the latter case, the privies are inside the dwelling and recourse is had to the mechanical action of the water for flushing and clearing them. The fecal matter is conveyed through pipes to the septic tank or directly to the purification lot.

In making the septic tank, 3.3 cubic feet of inside space is allowed per person. The energetic action of the bacteria on the surface of the soil has led to the creation of purification farms. Science has recognized that the work of decomposing organic matter is done most effectively in the upper twelve inches of the soil. The area required for 40 persons is calculated to be one acre of well-prepared land. To obtain good results the water must be made to flow in intermittently. Clayey or peaty soils are useless for this process, and frost and rainy seasons interfere with its efficiency.

Change Houses

Many mines, both great and small, have change houses with benches, wash-basins, shower-baths, etc. When the miners come to work they go to a building where they change their clothes for working ones. When they come out of the mine at the end of the shift with dirty clothes, they can leave them at the change-house, take a refreshing bath, tidy themselves and put on the clean clothing they left behind in the morning. The workman comes home neatly dressed, the cleanliness of the house is made to correspond and he himself feels in better humour. It must be borne in mind that one seldom finds baths and shower baths in miners' dwellings. The laws of some of the provinces of Canada and of several of the neighbouring states make the providing of a change house for every mine compulsory. The employees are not obliged to make use of them, but experience shows that the very great majority do avail themselves of these advantages. In some places a contribution of fifty cents per month is charged to each workman for the use of the change house.

As in the case of mine buildings, the choice of a site is an important matter. It should be near the exit from the mine shaft. Some laws, such as those of the state of Montana, fix the maximum distance at 800 feet. Remoteness from the steam boilers and facilities for draining off the water are factors to be considered. The size of the building, the number of wardrobes or hooks, wash-basins, shower-baths and water-closets must be in proportion to the number of workmen. On an average there should be one shower-bath per 20 wardrobes. The building must be in accordance with climatic conditions, so that a uniform temperature may be kept up inside. First-class ventilation must be provided. The workman must, of course, find at hand all the cold or hot water he wants.

In some places each workman has a metal wardrobe with a lock. These lockers generally measure 12 by 15 inches by 3 feet in height. The top and bottom are made of perforated sheet iron and the door of wire screen.

To assure better airing of wet clothing and prevent the soiling of clean garments, some of the most progressive establishments have movable hooks put up at 30-inch intervals, which can be hoisted up to the ceiling when required. The working clothes are put on these hooks; the workman hoists them up so as to leave a free passage underneath, and he fastens his rope to a padlock, whereof he alone has the key. In this case the wardrobes are used only for clean clothes. This method allows the working clothes to be better aired and dried and prevents soiling of street clothes.

The clothing room must be disinfected from time to time; and burnt sulphur is a safe disinfectant for this purpose. Burning five pounds of sulphur per 1,000 cubic feet of space suffices to thoroughly fumigate the room. Sprinkling the powder beforehand with alcohol is recommended. The openings must, of course, be hermetically closed for at least twelve hours.

Ventilation in Underground Mines

For the miners' greater welfare, the preservation of their health and providing satisfactory working conditions, mine managers must see to the sanitary state of the mines. Ventilation is a factor of the highest importance in connection with this. Under no pretext whatsoever should one neglect to make sure that there is a sufficient quantity of air, proportionate to the number of workmen present,

at the entry of each mine. It is empirically estimated that the quantity of air required per man is 300 cubic feet per minute. It must be borne in mind that the workman does a great deal more work under proper conditions as regards ventilation and temperature. Thus, from a humanitarian and economic standpoint, there is everything to be gained by assuring satisfactory ventilation and temperature.

Besides the advantage of assuring an additional exit in case of fire in the main shaft, the practice of sinking a second shaft opening on the surface at a suitable distance from the first, is an excellent and inexpensive means of providing air circulation. Thus the Eustis Mine, near Sherbrooke, Que., uses an old shaft with its mouth near the top of a hill 500 feet higher than the main exit. This old shaft acts as draught flue and, by means of a single board partition extending to the lower levels of the mine, the men working at the bottom, 4,000 feet from the mouth of the shaft, have an ample supply of good air. In cases such as this, the maintenance costs nothing, and the amount of capital to be spent for securing good ventilation is the mere cost of making the partition.

It frequently happens that, in connection with development work, blind galleries of a certain length are driven, without any exit. To carry off the air vitiated by the men's breathing, the gases and the fumes from explosives, recourse is had to forced ventilation. In many cases the compressed air for drilling machines is allowed to escape from the pipes. This method is more or less effective and is certainly expensive. It is advantageously replaced by installing a small blower which carries air to its destination through flexible tubes.

The presence, in the air of some mines, of sharp and hard dust from drilling and shovelling the ore contained in a silicious gangue, is injurious. This dust fills the lungs and gradually and inevitably causes pulmonary diseases among the workmen. To protect their employees to some extent against this danger, several companies use drills with water-jets, which beat the dust down. This practice is one to be encouraged.

Underground Latrines

Privies should be provided when more than 20 persons work underground; sanitation, cleanliness and decency call for this. It is also a protection against the danger of spreading typhoid fever,

tuberculosis and ankylostomiasis or hook-worm disease. To be of any use, a privy must be made according to sanitary principles, be in a convenient place, not too far from the place where work is being done, and kept clean. Technical magazines publish from time to time descriptions of latrines adapted to underground mine conditions.

In many places empty explosives boxes are used, earth or lime being spread over the excrements and these boxes are taken away every second or third day and burned.

Lunch-Rooms

At some large mines where open working is done, as at Thetford Mines, in the Province of Quebec, the owners have a lunch-room, near the exit from the mine, at the disposal of their workmen. Nothing is sold in the building, which is suitably furnished with tables and benches and chairs, and is heated in winter. When the men come to work in the morning they leave their dinner pails or baskets there. The yard mine watchman is responsible for the cleanliness of the house. He lights a small wood stove a few minutes before noon, so that the men may have hot water to make their tea. As a rule there is a supply of running water and a sink where utensils can be washed. There is also a box for refuse.

The data for this article are taken from the following magazines and publications:—

Sanitation of Rural Workmen's Areas. United States Public Health Service Reports, 1918.

Sanitation in Mining Villages. Technical Paper No. 33, United States Bureau of Mines.

Miners' Wash and Change Houses. Technical Paper 116, United States Bureau of Mines.

Rural Hygiene, by Ogden.

Prevention of Illness among Employees in Mines, by A. J. Lanza, M.D., A.I.M.E. Bulletin 146, P. 436.

Change House Benefits, by C. T. Willis, Safety Engineering, January, 1919, p. 9.

Le rôle technique de l'Ingénieur social, by T. Villain, Chimie et Industrie, vol. 2, No. 2.

GEOLOGY OF A PORTION OF THE PROJECTED TOWNSHIP OF LEMIEUX, COUNTY OF GASPE, P.Q.

By Adhémar Mailhiot

Introduction

This report presents the geological results obtained in a period of two months of field work, during the summer of 1918, in a region of the interior of the Gaspe peninsula, situated just east of the one which made the subject of the author's report for the year 1917.* This region forms a rectangular area of about seven miles by five miles, and is located on both slopes of the divide between Berry Mountain Brook, an affluent of the Grande Cascapedia river and Ste. Anne River. The report is followed by a field study of about three weeks on a serpentine mass, known as Mount Albert, which is located about 15 miles from the headwaters of Ste. Anne River, at the confluence of the lake and east branches of that river.

The writer was accompanied in the field by Mr. Conrad Manseau, a professor of the Ecole Polytechnique of Montreal, and Mr. Aimé Fauteux, a student in civil engineering at the same school, and he wishes to convey to both of these gentlemen his thanks and appreciation for their assistance in connection with this work. The writer wishes also to express his thanks to the owners of the Federal Mine, Messrs. T. O. Lyall and J. C. Beidelman, for their assistance. His gratitude is also extended to Dr. H. M. Ami and Dr. E. M. Kindle for identification of fossils from this region.

As this report covers a region adjacent to that which was explored last year, the same general descriptions necessarily apply, and the author refers the reader to the report published last year in the *Report on Mining Operations in the Province of Quebec during the year 1917*, for the geographical position and means of communication, previous explorations and field work, water supply, forests, mining conditions, and topography.

* A. Mailhiot, Geology of a portion of the projected township of Lemieux, County of Gaspe, P.Q. Rep. Mining Oper. in P.Q. during the year 1917—P. 117.

Geologically, the sedimentary and igneous formations described in the previous report extend to the east in the area under consideration, and we will be obliged to quote, in the present report, some petrographical and lithological descriptions from those made last year.

In the study and mapping of the various geological formations, we have adopted the same methods used the year before. From the Federal Mine to Lake Ste. Anne a portage trail was cut in the thick bush following the centre line of the rectangle which was to be explored. A stadia survey line was run along this trail with the object of making it the base of operation for subsequent surveys. The geological contacts were determined by pacing and prismatic compass. The survey of Lake Ste. Anne was made with the aid of a Rochon micrometer.

It is obvious that the geological outlines do not present a degree of great accuracy with the means used to determine them, but, at the same time, in this country heavily timbered, very difficult of access and unsurveyed, accurate mapping cannot be thought of.

With the exception of the two claims, Bois and Blois, on the western border, the whole region consists of unstaked lands.

Summary and Conclusions

The main geological results obtained during this work are the determination of the age of the sedimentary rocks which, owing to a collection of fossils identified by Dr. E. M. Kindle, an officer of the Geological Survey of Canada, were placed in the Grande Grève formation of Lower Devonian, and the relative age between the syenite and the quartz porphyry (which had been left undetermined last year), showing that the porphyry is younger than the syenite.

Petrographically, the study of Mount Albert has offered to the author an excellent example of a peridotite and pyroxenite sill in which the basicity of the magma decreases from the base to the top. The surface examination which was made in connection with the presence of chromite has lead the author to the conclusion that this mineral is found in a state altogether too disseminated in the serpentine to have an economic value; however, diamond drilling might discover pockets of valuable ore towards the more basic portion of the mass, at the base of the sill.

Topography

General.—As to the description of the general topography of Gaspé peninsula, and more particularly of that of the head waters of the Grande Cascapedia river, the reader is requested to consult the author's report, published in the Report on Mining Operations in the Province of Quebec during the year 1917," P. 124.

Local.—The portion of the township of Lemieux studied in this report occupies both slopes of the divide between Grande Cascapedia river and Ste-Anne river. Berry Mountain brook, a tributary of the Grande Cascapedia, is divided into three small branches which we have called respectively brooks A, B and C from north to south. These branches have their source at the foot of a syenite porphyry mountain west of lake Ste-Anne, and run parallel to each other in an approximately westerly direction. The western side of the divide has a relatively gentle slope and forms an area somewhat flat; there are no elevated and abrupt hills, no sharp peaks, and this feature contrasts with the topography towards the mouth of the Grande Cascapedia river, where the hills on both sides are high and rugged. The only high mountain of the region is the syenite porphyry mass west of lake Ste-Anne which has an altitude of 2,600 feet (above sea level) and which with its rugged type forms a contrast with the other hills of the region. This diversity of topography is due to long continued erosion under stable conditions; to the difference in hardness of the various kinds of rocks; and to the revival of the action of erosion under the effect of the uplift of the Appalachian Range.

General Geology

General Outline.—The Gaspé peninsula forms part of that geological province which American geologists, Schuchert (1) in particular, call "Acadia" and which comprises the entire area now occupied by the Appalachians from the gulf of Mexico to Newfoundland and Labrador; having the river St. Lawrence, the Great Lakes and the Mississippi on the one side, and the shores of the Atlantic ocean on the other. This peninsula constitutes the northern extremity of the great system of the Appalachian folds. As part of the Appalachian system, the Gaspé peninsula consists almost exclusively of paleozoic rocks. The Notre Dame or Shickshock mountains, forming the elevated plateau of the peninsula's interior (altitude 3,000 to 4,200

(1) Schuchert, Charles, Text Book of Geology 1915, P. 636.

feet) occupy the northern portion and contain patches of mica schists, jaspilites and epidotic gneiss, which evidently constitute the basement of the Cambrian schists, but it has never been established that these rocks are Precambrian. Many masses of peridotite, serpentine and granite are found there. During the paleozoic period, this part of the earth's crust was subjected to local and irregular movements; it was crumpled at various times and shoved to the northwest against the Laurentian plateau at the period of the great movements which gave rise to the Appalachians. These overthrusts are frequently masked by a mantle of more recent deposits.

The Gaspé peninsula seems to have escaped the eroding action of the great continental glaciers. Glacial deposits and striae are scattered and correspond only to the flow from local glaciers starting from the mountains in the interior. "According to Chalmers, the striae and direction in which boulders and till have been transported indicate that the ice which mantled the country around Baie des Chaleurs during the glacial period moved radially into it from the northwest and south, forming a local estuarine glacier. In the later stages the ice seems still to have pushed down from the high interior of Gaspé through such valleys as the Cascapedia and Nouvelle after it had disappeared as a sheet from the coast." (1)

During and after the Appalachian deformation, the Devonian shales were intruded by the plutonic rocks now occupying the great portions in the region studied in this report. These form four groups which are, according to their supposed order of intrusion: first of all, invasion and flow of the basic igneous rocks, then intrusion in a batholithic form of coarse-grained syenite closely followed by a flow of syenite porphyry, and the volcanic activity ended with the flow of granite porphyries, giving rise to the formation of veins of mineralized quartz intersecting the sedimentary rocks.

Below is a provisional table of the formations:

Post Lower Devonian:	Granite porphyry Syenite porphyry Syenite Basic igneous rocks.
Lower Devonian (*Grande Grève Formation*)	Sedimentary rocks.

(1) Goldthwait, J. W., Guide Book No. 1. International Geological Congress, Canada 1913, P. 119.

Sedimentary Rocks

General character and geographical distribution.—The sedimentary rocks of this region are formed of interstratifications of slates and limestone, occupying a band, of about one mile in width, with a direction northeast-southwest, bounded on the north by the granite porphyry and on the south by a group of basic igneous rocks. These formations are cut here and there by masses of syenite, syenite porphyry, and diabase. This band is traceable from the mining claims on the west, to beyond the Ste-Anne river on the east.

In the portion studied last year, these sedimentary rocks were exclusively formed of slates barren of fossils; in the region (east of it) studied this year, the rocks become more and more calcareous as one proceeds towards the east with a strike of S.45° E. and dip of 43° to the east.

The limestone is soft, dark gray in color, and nodular in appearance. It is occasionally very fossiliferous, in opposition to the slates which form the major portion of the staked claims.

Age of the sedimentary rocks.—A collection of fossils made at the divide between the Grande Cascapedia river and Ste-Anne river, was submitted to Dr. H. M. Ami and Dr. E. M. Kindle of the Geological Survey at Ottawa, for identification. Dr. Kindle's report reads as follows:

"I have examined the fossils from the headwaters of the Grande Cascapedia river, Gaspé peninsula, which you transmitted to me and have recognized the following species:

Fucoid or sponge
Zaphrentis corticata
Crinoid stems
Fenestella sp.
Annelid trail
Annelid tube?
Pholidops? sp
Chonetes hudsonicus
Strepheodonta? sp
Chonostrophia Dawsoni
Plethorhyncha pliopleura
Spirifer gaspensis

Spirifer Modestus var. *nitidulus?*
Athyris hera?
Eatonia peculiaris
Cypricardinia sp
Goniophora sp
Leptocoelia flabellites

"In addition to the fossils above listed the lot includes a piece of fossil mud-crack and one or two specimens representing concretionary aggregations."

"The fauna represents a Devonian horizon which appears to be equivalent of the Grande Grève beds."

Dr. Ami expressed himself as follows concerning Dr. Kindle's communication:

"These lower Devonian species belong to this marine paleozoic fauna to which I had formerly given the name of Grande Grève formation, term now used in the nomenclature of Eastern North American Devonian horizon.

"The fauna is interesting and many species are found in the Devonian beds of the Eastern and Atlantic coast of Gaspé peninsula, at Grande Grève, and in the vicinity of that classical spot where Billings and Logan established some very interesting data forty years ago."

Basic Igneous Rocks

General character and geographical distribution.—These rocks cover a great area in the southern portion of the region studied in this report; they form a transverse band from at least the vicinity of Brandy brook on the west, to beyond Ste-Anne river on the east. They occupy a great area on the western slope of the mountain west of lake Ste-Anne; they are also found on each side of lake Ste-Anne in its southern portion, and yet at the foot of the conical mountains to the east of lake Ste-Anne on their western slope; these rocks also form a considerable area on the left bank of the Ste-Anne river about one mile below the lake of the same name, and isolated patches are found cutting the limestones about the height of land between Grande Cascapedia river and Ste-Anne river. Among all the igneous rocks these occupy the largest area.

Petrography:—These rocks present to the naked eye a variety in texture and in the size of the grains; from very fine grained compact

rock to granular rock with large feldspar phenocrysts. Some varieties are vesicular and contain an infinite number of small globules of calcite surrounded by a green coating. In some specimens the globules constitute nearly one-half the rock volume. This green coating is also very frequently disseminated in the more compact rocks.

Under the microscope these rocks are seen to vary in mineralogical composition and texture from basalt to microgabbro. The fine grained specimens consist of aggregates of plagioclase and augite partially or totally transformed into hornblende. The groundmass in the vesicular varieties consists of the same elements as those of the compact rock, that is to say of aggregates of plagioclase and augite. Some varieties, with medium-sized, uniform grains, of an ophitic texture, of feldspar and augite, are real diabases while others have large phenocrysts of plagioclase in an aphanitic groundmass of uralitized pyroxene and soda-lime feldspar and may be classified as microgabbros.

All these varieties form part of the same igneous mass. The basalts pass laterally and vertically into more granular rocks and the latter into porphyritic varieties, the whole forming an exceedingly complex mixture.

The rocks probably represent products of volcanic flows on the surface of the sedimentary rocks of the Devonian period.

Syenite

General character and geographical distribution.—The syenite occupies a semi-circular area of about $1\frac{1}{4}$ square miles just east of the staked claims. It is cut by an intrusion of granite porphyry. It is cut in two by the brook B, and it comes in contact with the patch of granite porphyry located south of the Bois claim. It is the only mass which has been observed to the east of the staked claims, but the author is of the opinion that the syenite porphyry mass, which forms the major portion of the mountain west of lake Ste-Anne, represents an intratelluric phase of the igneous intrusion.

Petrography.—The prevalent colour of these rocks and of those associated with them is dark gray, sometimes tinted red by the orthoclase feldspar. With the increase in basicity, the colour changes and becomes uniform and darker, or dappled gray owing to the presence of small basic inclusions. The red varieties are found

in the mass described above. The texture of the syenitic rocks is holocrystalline and very uniform in the outcrops examined. Their structure is massive and intergrown everywhere. Under the microscope a slight crushing is sometimes seen, but not sufficient to have produced crushing planes. The jointage planes are very numerous and cut up the rocks into angular blocks.

Syenite Porphyry

General character and geographical distribution.—In the field it is easy to recognize the syenite porphyry by its general characters, for it has a reddish colour very characteristic, and a very pronounced porphyritic structure. The phenocrysts are always formed of big crystals of orthoclase feldspar and hornblende embedded in a fine-grained groundmass of red color. Quartz is never seen in this variety of rock of the township of Lemieux.

The syenite porphyry occupies a great area towards the headwaters of Berry Mountain brook, notably at the mountain west of lake Ste-Anne, and is also found east of the lake where it forms two round conical peaks, and appears to continue to the east towards Table Mountain. At the two localities just mentioned, the syenite porphyry cuts the basic igneous rocks, and it probably constitutes a finer grained phase of the syenite intrusion which has been described in a previous page of this report, and also in the author's report of 1917 on the Geology of the mining claims.

Petrography.—Under the microscope the syenite porphyry has a holocrystalline texture. Most of the thin sections which have been examined show a perfect porphyritic structure, with marked difference between the size of the phenocrysts and the constituents of the groundmass. The phenocrysts are formed of orthoclase feldspar generally cloudy owing to the presence of alteration products like kaolin and sericite. The orthoclase forms large tabular crystals often twinned after the Carlsbad law. When plagioclase feldspars are present, they form long flaky crystals with albite twinning. The hornblende also forms phenocrysts; it has the form of long flakes with a dark green colour having a tendency to alter into chlorite on the outer edges of the crystals.

The groundmass of the syenite porphyry is generally fine and rarely medium grained, and contains the same constituents that form the phenocrysts. Magnetite is the most common accessory

constituent. The secondary minerals developed are kaolin, sericite, chlorite among the larger crystals, and calcite in the groundmass.

Granite Porphyry

General Character and Geographical Distribution.—Among the intrusive igneous masses of the township of Lemieux, one of the most important is that of granite porphyry, which was described by the author last year, and to which he attributed the formation of the metalliferous veins of the region. This mass extends towards the east in the region which constitutes the subject of the present report, and it was possible to follow its contact beyond the Ste. Anne River. It is probable that this mass is not independent of the huge granite intrusion of Table Mountain, located about five miles east of Ste. Anne River.

This porphyry is essentially an acid felspathic rock, having a pale red or white colour, and presenting always to the unaided eye a porphyritic structure. The phenocrysts which can be seen without the aid of the microscope are quartz, feldspar, and sometimes biotite or hornblende. The feldspar and quartz are found in all the varieties, but biotite and hornblende are sometimes absent.

Petrography.—The granite porphyry presents a gradation from well-marked porphyritic rocks in which the constituents of the ground-mass are well developed and easily identified in the thin sections under the microscope, to those in which the groundmass is very fine grained and almost indeterminate. The first mentioned rocks are those which occur in the centre of the mass, at a certain distance from the edges. In these the phenocrysts are orthoclase, quartz, some plagioclase, and either biotite or hornblende, or both. The feldspars are always cloudy owing to the presence of alteration products. The quartz forms large rounded grains and often shows corroded borders. The hornblende is frequently completely altered to chlorite.

The groundmass of the granite porphry is holocrystalline and contains the same constituents which form the phenocrysts. It is always very fine grained, and contains small crystals of feldspar, interstitial and idiomorphic quartz, and generally much magnetite and pyrite as accessory minerals. The most frequent secondary minerals are sericite and chlorite. The porphyry is also cut by small quartz veinlets.

The granite porphyry represents the last phase of the volcanic activity in the region, and it has given rise to the filling of the fissures which now form the metalliferous veins of the township of Lemieux.

Geology of the Ore Deposits

General Outline.—All the mining claims of the region were staked after a discovery of blende and galena was made in 1910, at the spot where the shaft of the Federal Mine is now located. Two companies are now interested in the mining rights of that portion of the township of Lemieux, namely, Messrs. Lyall & Beidelman, who own an area of 3,000 acres, and the North American Mining Company, who holds claims having an area of about 600 acres. (See local geological map published in the Report on Mining Operations in the Province of Quebec during the year 1917.)

General Characters of the Metalliferous Deposits.—The ore occurs in well-defined veins, which have been uncovered on blocks H, D, and E, belonging to Messrs. Lyall & Beidelman, and on block L, the property of the North American Mining Company.

The veins contain blende (sphalerite), galena, quartz, and dolomite. The blende is usually in large or small masses of clean mineral varying from $\frac{1}{3}$ inch to several inches across, though smaller particles also occur. The galena is often in fair sized masses, but very generally occurs in quite tiny particles mixed with the quartz and the blende. The various minerals are absolutely contemporaneous. At the Federal Mine, the quartz vein is flanked in different places by a breccia formed of angular fragments of slates cemented with quartz and mineralized substance. The disposition of the veins and the conditions of their formation show that the fractures are deep and the ore will persist to great depths.

The ore is of excellent quality and the blende is in every way remarkable for its purity. The ore is identical in all the veins of the region.

Metalliferous Veins.—On the mining claim where the shaft of the Federal Mine has been sunk, the cleared tract exposes the outcrops of a number of veins. The vein on which the mine workings are now driven, runs along the eastern edge of the plateau which borders the right bank of Berry Mountain brook. This vein strikes

N. 25° E. and although only exposed for about 600 feet, lines up almost exactly with another outcrop on Bois claim, block E, about 3,000 feet further north. It dips westward at 70° from the surface down to the tunnel level and below is nearly vertical or dips steeply eastward.

Another vein, known as the McKinley vein, forms an abrupt cliff of 50 feet in height on the slope of the hill towards Berry Mountain brook. It is a compound vein, formed of two parts, measuring in all 60 feet in width, and flanked on both sides with a mineralized breccia. Its strike is N. 15° W.

Another vein outcrops at the eastern corner of the cookhouse; its strike is N. 30° W., and its width is 8 feet.

Another vein outcrops near the pumphouse, and there are a few others showing in the clearing, but their outcrops are limited, and upon which very little trench work has been done.

On the Gilker claim, block "D," immediately north of the south line, a shaft has been sunk having a depth of about twenty feet on a vein outcrop.

On the Bois claim, block E, a shaft is being sunk by Messrs. Lyall & Beidelman, which is now 60 feet in depth.

On the claims of the North America Mining Company no prospecting work has been done during the year 1918, and therefore the description of the veins of these claims is the same as that which was made by the author in his last year's report. This last company has staked two new claims east of blocks "E," "J," and "N," where the stakers claim to have found good surface showings.

Mining Developments

Surface Workings.—During the year 1918, Messrs. Lyall & Beidelman have performed considerable trenching on the mineral claims which they have staked along the mine road, to the south of the Federal Mine, between Berry Mountain and Brandy brooks. This work, which consists of surface trenches, does not seem to have uncovered any metalliferous veins in place, although loose blocks containing blende and galena have been found in the drift covering the solid rock. Messrs. Lyall & Beidelman have also performed mining work on block E. They have sunk, on an ore outcrop, a

shaft which is now (April 1st, 1919) 60 feet deep. It is reported that the vein at this depth is 9 feet wide.

Underground Workings.—The only underground work of this region has been performed by Messrs. Lyall & Beidelman, at the Federal Mine, on block G. These workings consist of a shaft which was originally inclined following down the ore on a dip of 70° westward and which has since been straightened. This shaft is now 142 feet deep. At the 100 foot level, a drift and many crosscuts have been driven. The main drift has a portal on the slope of the valley of Berry Mountain brook. The total length of the underground workings is about 1,700 feet.

GEOLOGY OF MOUNT ALBERT, COUNTY OF GASPÉ, P.Q.

By Adhémar Mailhiot

General Outline.—Mount Albert is situated on the left bank of Ste-Anne river, near the forks of that river, at a distance of about 25 miles, in a straight line, from the St. Lawrence river, and at a distance of approximatively 10 miles from lake Ste-Anne. The Ste-Anne river, which flows in a direction approximately north from the lake, makes a sharp bend towards the west after it has passed Mount Albert, and follows the general strike of the formations for a distance of about 15 miles, and then again it flows in a northerly direction and joins the St. Lawrence river at Ste-Anne-des-Monts. At the northeast foot of Mount Albert the Ste-Anne river is divided into two branches, the first with a direction approximately west is known as the east branch; the other, the lake branch, flows in a northerly direction.

Mount Albert forms a very high mountain, its altitude being 3,700 feet above sea level, which dominates all the other surrounding hills, and constitutes, with Table mountain (altitude 4,200 feet) to the east, the axis of the Notre-Dame or Shickshocks range. Its summit is totally denuded and forms an almost flat surface of about four miles long in an east and west direction, and two miles wide in a north and south direction. Certain portions of the summit are absolutely flat and present a true glacial surface with here and there some gentle undulations or rocky knolls which have been spared by the glaciers. In general these small knolls present a gentle slope towards the north and an abrupt face towards the south, and this feature would prove that the glaciers were advancing from north to south. On the summit plateau are found a few erratic blocks of granite and hornblende schist which certainly represent remnants of ancient glacial moraines. These blocks are also found in the branches of Devil Brook in the interior of the peridotite area. These hornblende schists are identical to those found in place below at the bottom of Devil Brook and to the east of the serpentine mass.

The slopes of Mount Albert are denuded and abrupt on the south side of the mountain, whilst the north side, facing the Ste-Anne river, is timbered to the top. The sides are deeply cut by

brooks, which radiate in all directions from the summit, forming deep and abrupt valleys. The most important brook is the one known as Devil Brook. It flows in an easterly direction and empties into the Ste-Anne river about two miles above the forks on the west bank of the river. Towards its head this brook divides into at least three principal branches; the most important runs south and has a length of about one mile, forming a ravine in the mountain; another, whose direction is southeast, branches from the first one at about half way along its course; and a third keeps the same direction as the main branch, that is easterly. The total length of these branches, from the point where the brook enters the serpentine mass, is about four miles. These various branches take their source at the summit of Mount Albert and drain a series of small lakes and springs. Devil Brook thus separates, by its long and abrupt valley, a narrow crest in the southern portion of the mountain. The bottom of Devil Brook is relatively flat with a uniform slope towards its mouth which it keeps until the Brook flows over the hornblendites and quartzites forming the border of the serpentine mass, and then falls vertically approximatively 50 feet, apparently caused by a fault in the precambrian (?) rocks. Towards the head of the brook the slope is much steeper and soon becomes precipitous,—then the brook has the appearance of a cascade.

An affluent on the left bank of Devil Brook meets the latter at about one mile above the fall; this affluent is very steep and follows the line of contact between the serpentine and the hornblendite. The bed of the brook is covered with partially rounded loose blocks having diameters up to ten feet, which have fallen from the sides of the mountain. Some of these blocks present glacial striae on one face.

Peridotite, Hartzburgite and Bronzitite.

The medium type of the peridotite of Mount Albert is essentially formed of peridot-olivine and bronzite, it is really a hartzburgite, but all gradations are found from the rock totally formed of grains of olivine more or less serpentinized, the peridotite, to the rock wholly formed of crystals of bronzite, the bronzitite.

The peridot-olivine is generally coarse grained; this caused the coarse structure of the peridotite which had only one stage of cooling and of solidification and in which it is impossible to recognize the order of crystallization.

In the peridotite of Mount Albert the content of iron is relatively small, and so the predominant type of bronzite, which accompanies the peridot, approaches the enstatite. This rhombic pyroxene does not exist as regular grains, but it forms large crystals. The enstatite, in the vicinity of the rock surface, is generally transformed into bastite having a metalloid luster, which causes the black stains of the serpentinized peridot to show prominently among these crystals.

The hartzburgite type is the most common; it forms the major portion of the mountainous mass; the peridotite type is found on the southern border, and the bronzitite type on the northern border of the mass. Moreover, the bronzitite is essentially associated with the peridotite in the centre of the mass where these two rocks form small differentiation masses. The bronzitite is a light coloured rock and contrasts with the darker peridotite. In the bronzitite, the bronzite is the sole mineral or it is sometimes associated with the serpentinized olivine and the chromite. The bronzitite alters very readily in giving a serpentine wholly formed of bastite.

Decomposition products of the Peridotite.—The type of the alteration is the serpentinization. Serpentine has long been considered as a distinct mineral species. The microscopic study has shown in a definite manner that it really forms a rock essentially constituted with alteration products derived from magnesian silicates, pyroxenes, amphiboles, and especially peridot-olivine; these products are frequently isolated in fissures where they take various forms. The serpentine is a compact rock with conchoïdal or lamellar fracture planes; its colour is generally green of various shades.

In the peridotite of Mount Albert, the olivine is xenomorphic. The crushing has produced some fractures and it is along these planes that the serpentinization has taken place. Under the microscope it is seen that one crystal develops along a fracture, and has the shape of a blade which bends along the sinuosities of the fissure. When the alteration of the olivine is complete, the latter presents a reticulated structure. The links are constituted by the ribbons of serpentine which have just been described, and the centre is formed by a serpentine crystal having a different optical orientation from that of the peripheric ribbons, or by a dark colloidal substance. The formation of chromite is frequent in these

central portions, the serpentine being less ferruginous than the olivine from which it is derived.

The bronzite is also sometimes serpentinized and altered into bastite; then the cleavage planes of this mineral, replacing the bronzite, have a metalloid aspect. Under the microscope it is seen that this alteration takes place by gradation in the mineral in keeping the same optical orientation, and in this manner one crystal of pyroxene, totally altered, corresponds with one crystal of alteration product.

The exact cause of the serpentinization of peridotite is not yet known, but has been attributed by various authors to the contact effect of igneous intrusions, or to the action of meteoric waters circulating through the earth's crust. Whatever the primary cause, the serpentinization seems to be the result of the action of time, for the older the peridotite the more likely it is to have become altered to serpentine.

Atmospheric weathering takes place at the surface of the serpentine to a depth of about one inch. The colour of this outer shell is yellow buff, and under the microscope it is seen to consist of serpentine, carbonate of magnesia, and grains of chromite which stand in relief on the surface giving to the latter a rugose appearance. In certain places along zones of shearing or contraction fissures, the alteration goes deeper into the rock. Under the effects of weathering the serpentine desintegrates and gives rise to spherical and rounded forms, and it breaks off in small foliated fragments.

Chromite.—Besides olivine and bronzite the only other constituent visible under the microscope is chromite which forms isolated grains, irregular veins, and nests. This mineral originated from the transformation of olivine into serpentine. The veins vary in width from $\frac{1}{3}$ of an inch to two inches, and the mineralized zones run up to two feet in width. The veins and the zones are located in restricted points, whilst the isolated grains are abundantly disseminated through the entire mass. Picrolite is also sometimes found along certain shearing zones in the rock. The fibre is brittle and lays in a parallel direction to the fissures in which it is found.

Chromite is an abundant accessory mineral in the serpentine of Mount Albert, and in the thin sections examined under the microscope, it occurs in large crystals disseminated through the

section, or in small rounded grains aligned along the veinlets of serpentine in the peridotite, or occupying the central portion of a primary olivine crystal. The last disposition is particularly striking in natural light where the serpentine ribbons are limpid whilst the centre of the crystal is shot with black opaque particles of chromite. When the disposition of grains in line is present, these grains represent the original contours along which the serpentinization began.

Chemical Analyses.—Chemical analyses of two samples of rock from Mount Albert are given below; the first sample could be considered as a typical peridotite, for it is exclusively formed of olivine grains slightly serpentinized, and was collected at the south summit of the mountain; the second sample is totally formed of bronzite crystals, it is then a bronzitite, and was collected on the northwest flank of the mountain. These two analyses were made by Mr. C. Bousquet, chemist at the Assay Laboratory of the Provincial Government at the Ecole Polytechnique of Montreal.

	1	2	3	4
SiO^2	37.24	43.52	38.40	42.99
$A1^2O^3$	0.30	0.65	0.29	1.11
FeO	8.01	6.98	10.11	7.78
MgO	41.18	42.74	45.23	43.14
CaO	0.29	0.85	0.35	0.10
P^2O^5	0.03	0.02	0.06	0.05
Cr^2O^3	0.49	0.68	0.07	.....
NiO	0.56	0.38	0.10	0.15
H^2O	11.04	3.60	4.35	4.51
MnO	0.26	0.29	0.24	0.05
		K^2O, Na^2O^5	0.08	Na^2O 0.29
		CO^2	1.10	K^2O 0.13
	99.40	99.71	100.38	100.29

1. Peridotite from Mount Albert.
2. Bronzitite from Mount Albert.
3. Peridotite from Eagle Creek, British Columbia, C. Camsell, Memoir No. 26, Geological Survey of Canada, 1913.
4. Hartzburgite from Santa Rosa Creek, Rossland Mountain, B.C. R. A. Daly, Memoir No. 38, Geological Survey of Canada, 1912.

The calculation of the norm by the American method of the quantitative classification gives the following percentages for the various constituents:

Rock No. 1.—Peridotite from Mount Albert:

	%
Chromite	0.67
Apatite	0.07
Anorthite	0.83
Wollastonite	0.16
Hypersthene	8.81
Olivine	77.00

Rock No. 2—Bronzitite from Mount Albert:

	%
Chromite	1.01
Apatite	0.03
Anorthite	1.78
Wollastonite	1.73
Hyperstheme	26.40
Olivine	64.49

Conclusion.—Mount Albert offers an excellent example of a peridotite and pyroxenite sill in which the basicity of the magma is decreasing from the base to the top. The superficial examination which was made in connection with the presence of chromite has lead the author to the conclusion that this mineral is found in a state altogether too disseminated in the serpentine to have an economic value; however, diamond drilling might discover pockets of valuable ore in the more basic portion of the mass, at the base of the sill, that is to say, along the southern border of the mountain.

LANDSLIDE ADJACENT TO RIVIERE BLANCHE, ST. THURIBE, PARISH OF ST. CASIMIR, PORTNEUF COUNTY, P. Q.

*By M. E. Wilson and B. R. MacKay**

General Data

Within historical times, numerous landslides, attended in most cases by great destruction of life and property, have occurred adjacent to the Ste. Anne, the Lièvre, and other rivers, which have incised their courses in the stratified marine clay, silt, and sand that underlie the lowland flats to the north of the lower Ottaw and St. Lawrence rivers. The locality, area, and date of occurrence of the most important of these landslips are included in the following table, but these represent only a small part of the landslips that have actually occurred in this territory, for there are numerous areas in the lowland flats adjacent to the rivers and tributary streams that exhibit the characteristic hummocky topography that results from such land movements.

Principal landslips known to have occurred in the St. Lawrence lowlands of Quebec within historical times:

Locality	*Area (approximate)*	*Date*
Maskinongé River, Maskinongé Co.	84 acres	April 4, 1840
St. Alban, on Ste Anne River, Portneuf County	1,000 acres	April 27, 1894
St. Thuribe, on Blanche River, Portneuf County	85 acres	May 7, 1898
Poupore, on Lièvre River, Labelle County	95 acres	Oct. 11, 1903
Notre-Dame-de-la-Salette, on Lièvre River, Labelle County	6 acres	April, 6, 1908

The principal causes to which these landslips owe their origin are the following:—

(1) The dissection of the rivers, which cut deep valleys for themselves in the fine, easily transportable, unconsolidated clay, silt and sand in which they have their courses.

*Memorandum addressed to Mr. William McInnes, Directing Geologist, Geological Survey, Ottawa. Published by kind permission.

East face of landslip depression—Lot 270—St. Thuribe, St. Casimir Parish, Portneuf County, Que.

(2) The presence of silty and arenaceous beds, which, when saturated with water, become plastic or muddy and thus serve as a lubricant for the movement of the more coherent portions of the landslip mass towards the adjacent river valley.

(3) Certain climatic conditions such as (a) the rapid melting of the winter's snow in the spring time, (b) the proportion of the water derived from the melting of the winter's snow that is absorbed by the underlying ground (determined by such factors as the thickness of ground frozen in the winter or the rapidity with which the ground thaws in the spring time), or (c) prolonged periods of heavy rainfall.

(4) The presence of a depositional dip in the beds of clay, silt and sand in the direction towards which the landslip occurs.

Local Data

The region in which the landslips have occurred in St. Casimir Parish, Portneuf County, Quebec, lies in a flat underlain by strati-

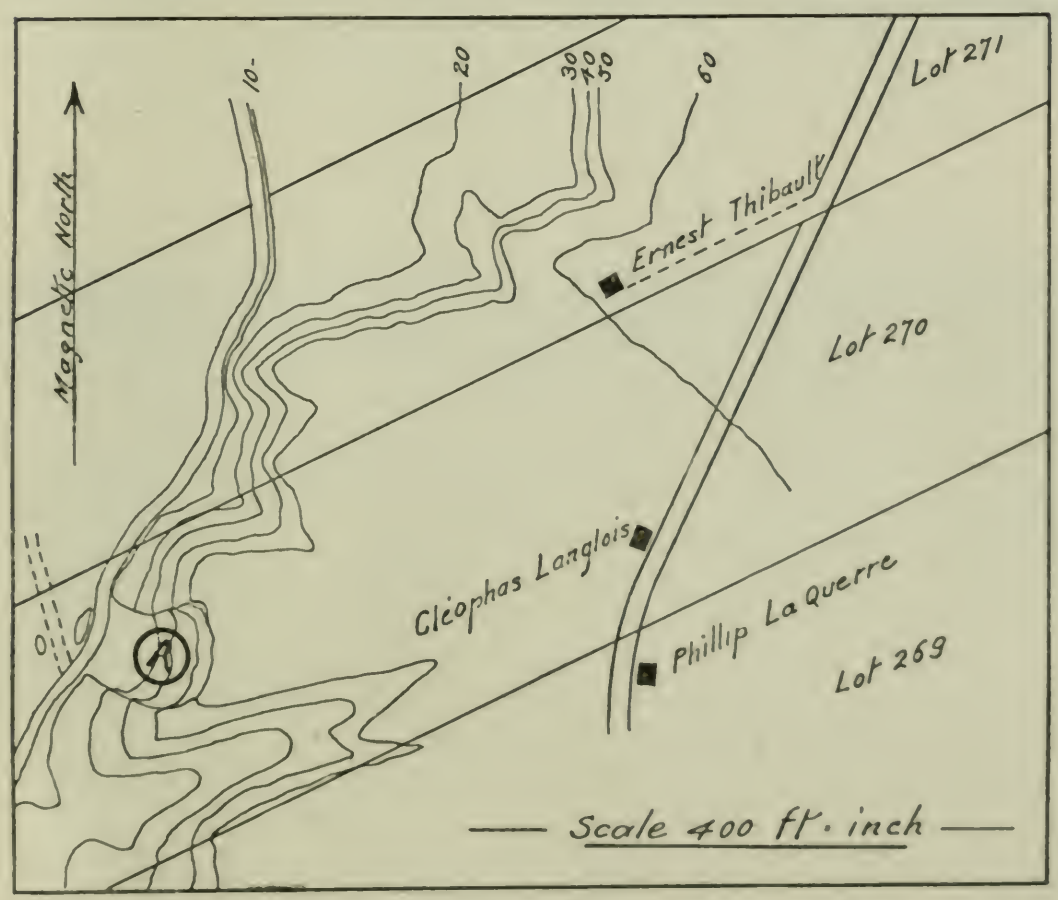


Fig. 1.—Contour map of east bank, Blanche river showing landslip (Point A) of April 1919.

fied silty clay and silt, in which the Blanche and Noire rivers, tributaries of the Ste. Anne River, have cut out valleys from 50 to 60 feet deep and 1,000 feet in width. The local conditions that prevail are indicated on the accompanying plans (Figures 1 and 2).

On lots 274 to 278, at the north end of the landslip zone, there is a broad amphitheatre-like area possessing an irregular hummocky surface similar to that characteristic of areas in which landslips are known to have occurred. Since the inhabitants of the district have no knowledge of a landslip at this point, this depression was presumably formed by a landslip in pre-historic times. It has an area of approximately 100 acres.

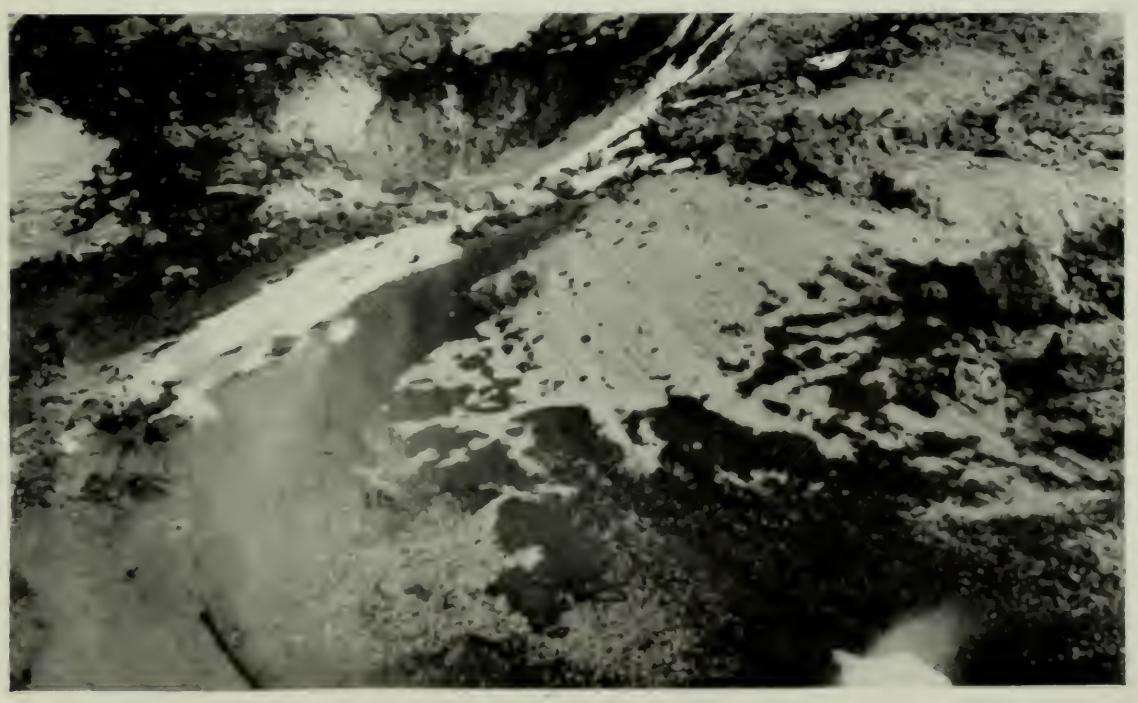
Directly south of this pre-historic landslip depression there is the amphitheatre developed by the landslip of May 7th, 1898. The manner in which this landslip occurred and the effects which it produced are described by Monseigneur J. C. K. Laflamme, in the Report of the Department of Colonization and Mines of Quebec, for the year 1898, as follows:—

> "On the 6th May, a veritable landslide took place at the spot there, on the following day, the outlet for exit was to open.
>
> "But the people, who were accustomed to accidents of the kind, paid no heed to it. On the following day at 5 a.m. they began to hear what sounded like a series of detonations and the persons who dwelt in the houses that were swallowed up in the catastrophe had barely time to escape being crushed under the ruins of the falling buildings and to seek refuge on the firmer soil.
>
> "Then a mass of muddy clay was seen to flow in a thick stream towards the neck and pour into the river. Then successively immense blocks detached themselves from the banks of the part that had already sunk and plunged and disappeared in the sea of mud, to arise a little further on, seeming to float like ice on water, and to float toward the narrow outlet to the river. This lasted from five o'clock in the morning until nine. At that moment the vast amphitheatre that is now to be seen was formed and the removal of the clay gradually ceased.
>
> "During their passage through the narrow outlet the blocks of clay swept down as fast as a horse can gallop. They

PLATE II.

East face of landslip depression—Point "A" of maps—Lot 270—St. Thuribe, St. Casimir Parish, Portneuf County, Que.

PLATE III.



Striae on Clay surface—Bottom of landslip depression—Lot 270—St. Thuribe, St. Casimir Parish, Portneuf County, Que.

broke up on contact with each other, and eye-witnesses state that the spectacle was truly terrifying. The moving sand seemed comparatively dry: the people assure that they saw not a drop of water.

"The wave of sand naturally followed the bed of the river. Not only did it fill up that bed, but it covered all the alluvial points . . . . for a distance of 40 arpents, causing damage to the riparian proprietors to the extent of over $60,000."

At the west end of lot 270, the farm of Cleophas Langlois, a third amphitheatre (Point "A", figures 1 and 2) has recently developed in the face of the embankment adjoining the valley of the Blanche River. The length of this pit is 200 feet, the width at its centre 170 feet, and at the point where it debouches into the river valley 130 feet; the height of the top of the face above the water of the river is 52 feet. The landslip at this point has evidently occurred in two stages, for two separate knobs of landslip material lie across the river opposite the depression. The eastern face of the pit as it existed on April 4th, 1919, is shown in plates I and II. The striae formed on the surface of the silty clay in the bottom of the pit by the movement of the sliding masses are shown in plate III.

The family of Cleophas Langlois, the farmer to whom lot 270, on which this landslip has occurred, belongs, state that they heard rumblings similar to those heard prior to the landslip in 1898, on the night of Monday, March 31st.

Conclusions

The principal conclusions that may be inferred with regard to the possibilities of an extensive landslip occurring adjacent to the Blanche River, on lots 269 to 274, Black River range, St. Casimir parish, Quebec, are the following:—

(1) The geological conditions prevailing in the area in question are similar in every respect to those which formerly existed in the adjoining district to the north, where landslips have already occurred.

(2) The areas lying between the depression formed by the recent landslip on lot 270 and the adjacent ravines to the north and south

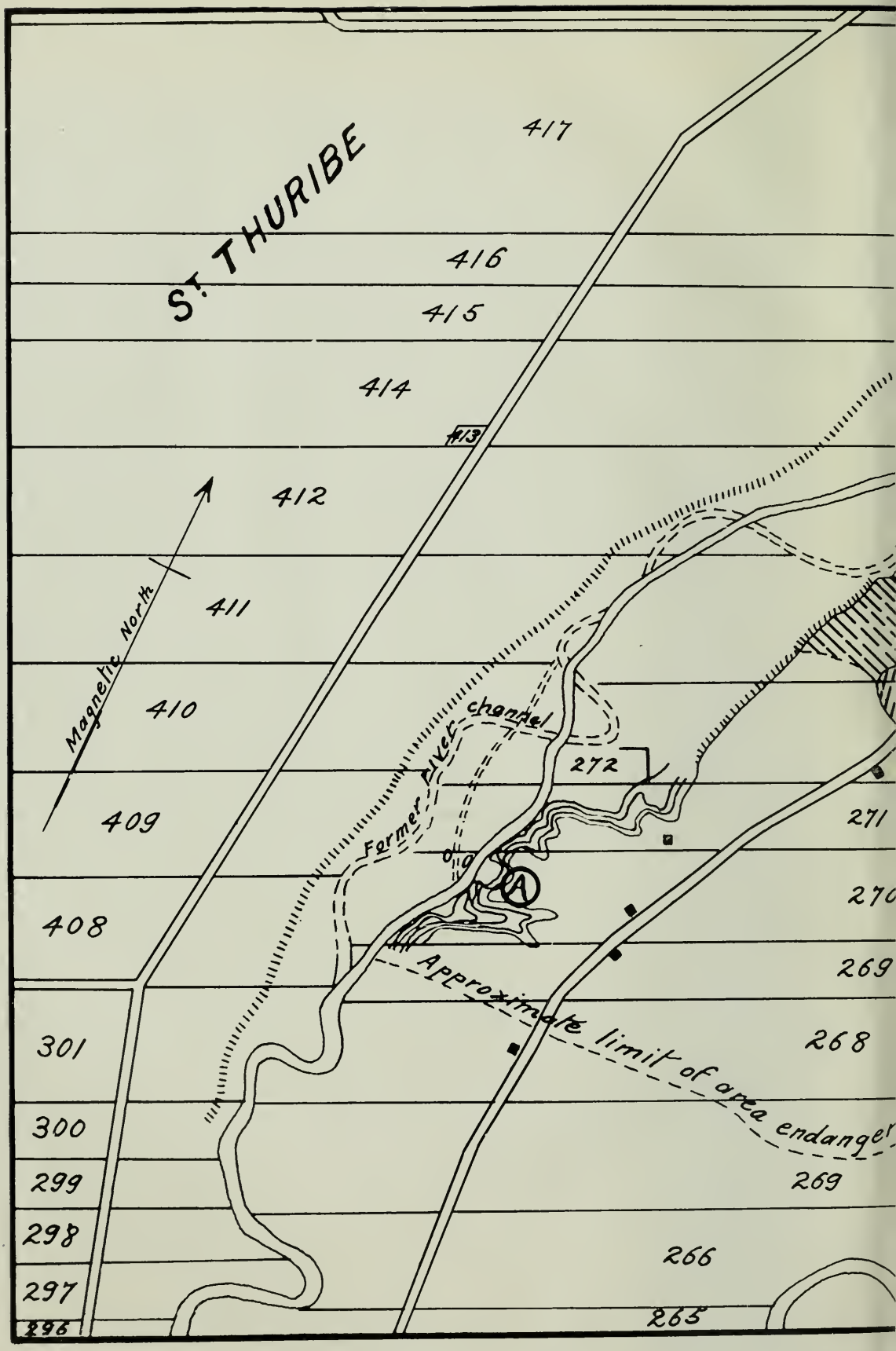
are in an unstable condition, and during periods of spring flood or at times of continued rainfall are in imminent danger of being precipitated into the river.

(3) If the areas adjacent to the landslip depression should collapse at a time when the silty beds underlying the lowland to the eastward are saturated with water, part, or all of the endangered area indicated in figure 2 might be engulfed.

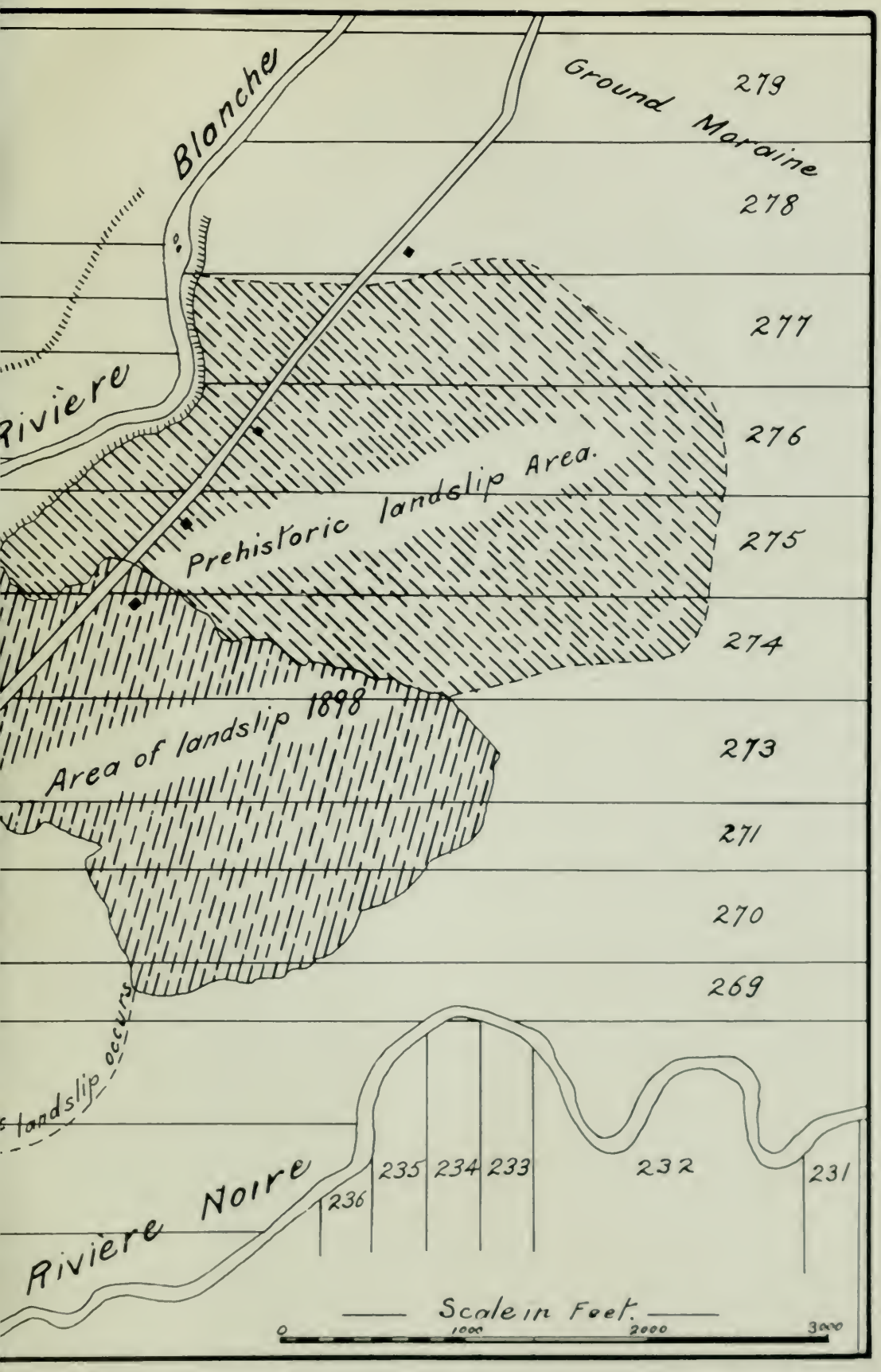
(4) The factors which control the supply of water to the silty beds, and hence determine when the landslip might occur, are climatic—that is, the rapid melting of the snow in the spring time, etc.

(5) Experience has shown that landslips rarely occur except in the spring time or during occasional periods of prolonged rainfall in the autumn, and little risk is, therefore, incurred by the inhabitants in occupying the endangered area except at such times.

OTTAWA, 23rd April, 1919.



Map showing location of landslips in St. Thuribe, St. Casimir Pa



Portneuf County, Que.—Point "A" indicates landslip of 1919.

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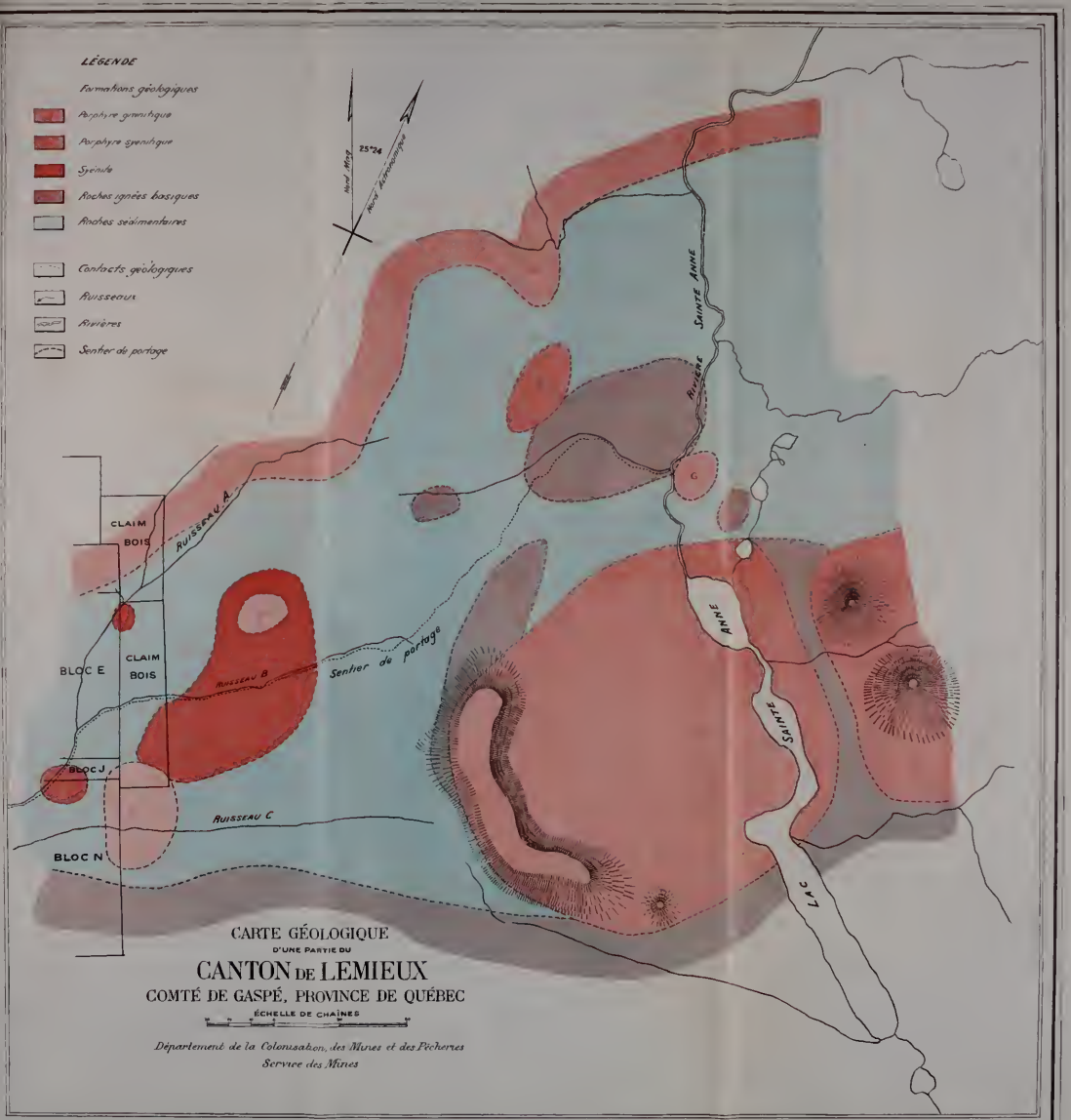

CARTE GÉOLOGIQUE
D'UNE PARTIE DU
CANTON DE LEMIEUX
COMTÉ DE GASPÉ, PROVINCE DE QUÉBEC

ÉCHELLE DE CHAÎNES

Département de la Colonisation, des Mines et des Pêcheries
Service des Mines

POUR ACCOMPAGNER LE RAPPORT DE M.A. MAILHIOT